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Performance of a Compound Pumping Engine.

On this page we present an engraving of the Leavitt Pumping Engine, of which several are now in use supplying water to large cities. Two immense Leavitt Engines are now building to pump the sewage from the city of Boston into the ocean. Each of these will weigh 900,000 pounds. The following report of tests of a Leavitt Engine, made for Park Benjamin's Scientific Expert Office, will be found of considerable practical value. The result of these tests, also of the Corliss and the Holly Pumping Engines, all made by Mr. Richard H. Buel upon the same general plan, were published in our issue of August 16, 1879.

Report of Tests of the Leavitt Pumping Engine.

New York, July 30, 1879.

To E. D. Leavitt, Jr., Esq.,
Cambridgeport, Mass.

Dear Sir: The following report of the trials made with the Pumping Engine at Lawrence (Mass.) Water Works, by Mr. Richard H. Buel, representing this office, is respectfully submitted:

Description of the Engine.

There are two Pumping Engines at the Lawrence Water Works, similar in design, with a single fly-wheel between them. The Engines are designated as "A" and "B," and the trial in question was made with the "A" engine. This is a compound beam engine, the steam cylinders of which are inclined outwardly at the top to connect with opposite ends of the working beam. The cylinders are jacketed on the sides and heads, steam of boiler pressure being used in the jacket of the high pressure cylinder, and steam of a reduced pressure in the other jacket. The drainage from these jackets is ordinarily returned directly to the boilers, but, on the occasion of the trial the connections with the boilers were broken, and the jacket drainage was allowed to mingle with the other feed-water drawn from the hot well.

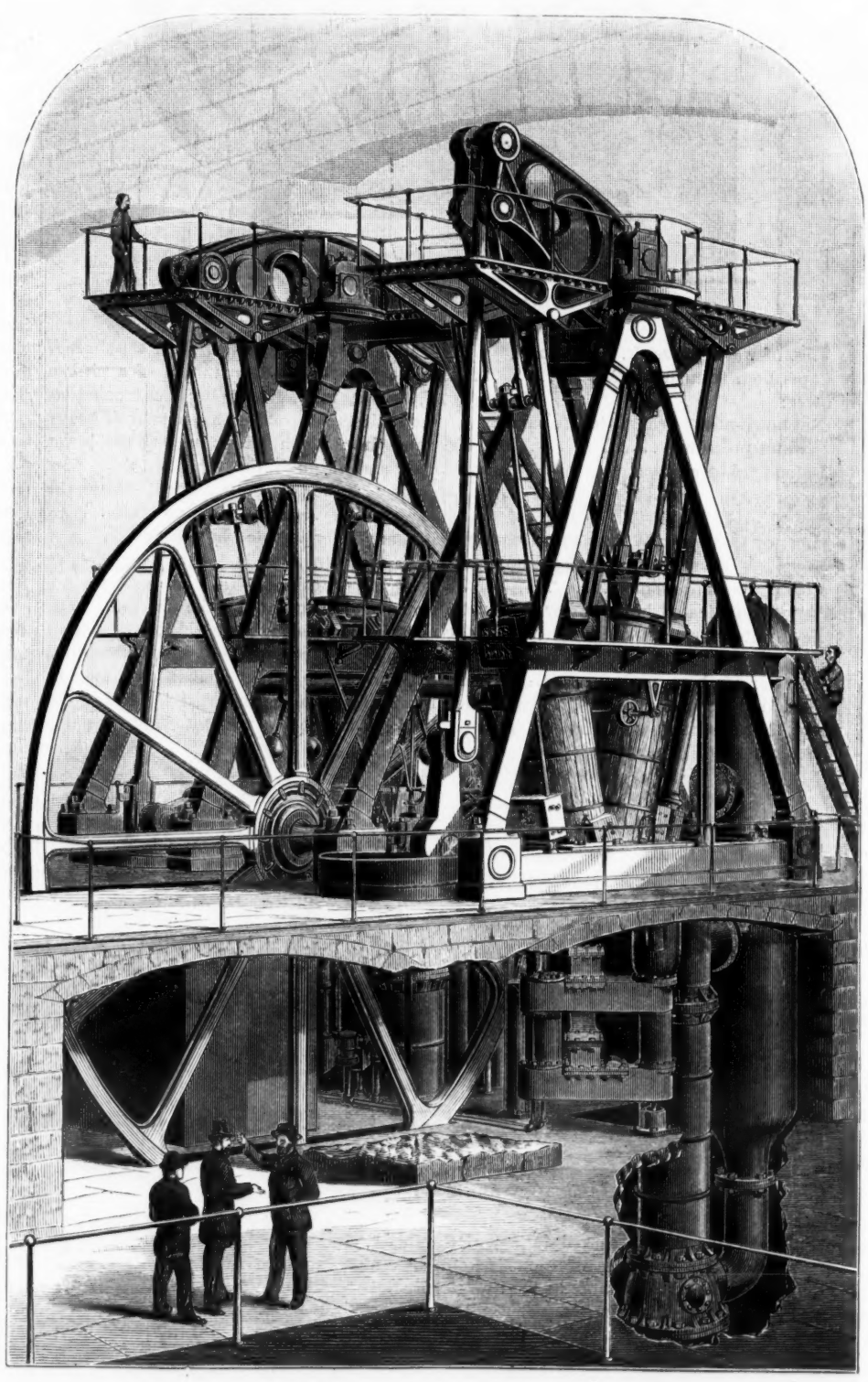
The steam and exhaust valves are gridiron slides giving large openings with small movements. The valves are actuated by cams which are driven by gearing from the crank-shaft, and a centrifugal governor adjusts the cams, operating the steam valves of the high pressure cylinder so as to vary the point of cut-off and maintain a constant engine speed.

The pump is driven by a connecting rod attached to one end of the working beam. The pump consists of a plunger to which is attached a bucket with valve opening upward.

There are seven receiving valves, and four delivery valves, in addition to the valve in the bucket, the water being discharged from the pump through two delivery pipes, above and below the bucket respectively. The pump valves consist of loaded rubber disks with central guiding stems. The original valves were of metal, double beat, and the introduction of the present form has greatly increased the pump's efficiency.

Principal Dimensions of the Engine.

Diameter of high pressure cylinder	18 inches.
Diameter of low pressure cylinder	38 inches.
" " pump barrel	26.125 "
Stroke of steam and water pistons	8 feet.
Diameter of high pressure piston rod	3.5 inches.
Diameter of low pressure piston rod	4 inches.
Diameter of plunger rod	4.5 "
Diameter of plunger	18.5 inches.
" " air chamber	54. "
" " air pump	15. "
Stroke of air pump	28 inches.
Diameter of fly-wheel	30 feet.
Weight of fly-wheel	35,900 lbs.
Clearance, high pressure cylinder, top	2.56 per cent
Clearance, high pressure cylinder, bottom	2.31 "
Clearance, low pressure cylinder, top	1.54 inches.
Clearance, low pressure cylinder, bottom	1.82 "
Connecting pipe between cylinders of high pressure cylinder capacity	9.92 "
Area of opening receiving valves	500.3 sq. in.
" " delivery valves	285.9 "
" " bucket valve	261.45 "
Length of force main	4,900 feet.
Diameter " "	30 inches.
Diameter of branch to pump	24 "
Length of engine, over all	42′–6½ "
Width " " " (both engines included)	27′–10½ "
Height of engine, over all, above main floor	30′—
Height of engine above bottom of pump	55′—



The Leavitt Pumping Engine.

Boilers.

There are two boilers, tubular, with combustion chambers internally fired and having return flues beneath their shells. One boiler was used in the test, and the principal dimensions are as follows:

Length of boiler	25.46 feet.
Diameter of circular shell	5.25 "
Number of tubes	80
Outside diameter of tubes	3 inches.
Grate surface	28.75 sq. ft.
Heating surface, Furnaces	115 "
" " Combustion chamber	158 "
Heating surface, Tubes	573.5 "
" " External shell	173.5 "
Heating surface, Total	1020. "
Ratio of heating to grate surface	35.5
Ratio of cross section of tubes	0.117
Height of chimney above grate	120 feet.

Manner of Conducting the Duty Trial.

Before commencing the trial, the scales used for measuring coal and feed-water were tested by standard weights and found to be correct. The steam and water pressure gauges were tested by comparison with a correct mercury gauge, and the vacuum gauge was also tested. The scales of the springs used in the indicators were obtained by experiments under steam pressure. To determine the amount of feed-water used, it was drawn by the engine feed-pump alternately from two barrels placed on platform scales, 800 pounds of water being taken from each barrel at a draught. The drain pipes from the cylinder jackets were arranged so as to discharge into either of these barrels at pleasure, and the main supply of feed-water was drawn from the hot well.

Before starting the trial, the fires were hauled from the furnaces, the ash-pits cleaned, and the fires were rekindled with wood, the steam pressure and water level at the time of starting being noted. Coal was added as soon as possible, and when the fires were in sufficiently good condition the trial was commenced and continued until after he last firing, the steam pressure had fallen to the point at which it stood at the time of starting fires, the water level being also the same. On stopping, the fires were hauled and the unconsumed coal was picked out. All fuel put into the furnaces (including the wood, which was estimated as equivalent to $\frac{4}{10}$ of its weight in coal) was charged to the experiment, except the amount of unconsumed coal contained in the fire at the close of the run. It is believed that this is the only method of measuring the coal burned during a test that is free from error. The coal used was Cumberland, of excellent quality.

The revolutions of the engines during the trial were recorded by a counter, and the water pressure was measured by a gauge placed at a height of 29.05 feet above the level of water in the pump well. The average reading of this gauge, added to the pressure per square inch, equivalent to the height of the column of water below the gauge, was taken as the water pressure. The

level of water in the well below the gauge was indicated by a float, and was recorded at frequent intervals during the run.

It will be seen from the above that great pains were taken to measure with precision the elements necessary for a computation of the duty, and to avoid all allowances and guess-work.

Results of the Duty Trial.

The results of the duty trial are as follows:

Pounds of wood used to start fires	400
" coal put into furnaces	3,500
" " withdrawn from furnaces at end of trial	27
Pounds of coal consumed (400 × 0.4 + 3,500 − 27)=	3,633
Pressure on main by gauge lbs. per sq. inch	64
Water level in well below gauge (ft.)	29.05
Water pressure, lbs. per sq. in. (29.05 × 0.433 + 64)	76.6
Area of pump bucket (sq. in.)	536.0465
Revolutions of engine	12,337

Duty of engine, ft. lbs., per 100 lbs of coal.

$$\frac{(536.0465 \times 8 \times 12{,}337 \times 76.6 \times 100)}{3.633} = 111{,}548{,}925.$$

Numerous indicator diagrams were taken during the trial, and are fairly represented by the accompanying sketches, the upper diagram being from the low pressure cylinder, and the other from the high pressure cylinder. It will be seen that the steam distribution is very satisfactory, a result which is due to the effective valve motion already described. The principal results obtained from a calculation of the diagrams are appended:

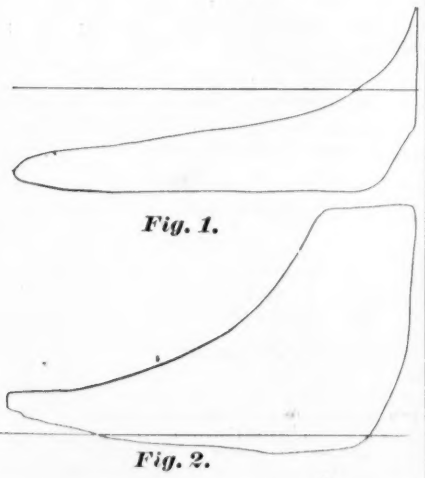


Fig. 1.

Fig. 2.

Scale of high pressure diagrams, by experiment	1 in. = 39.1 lbs.
Scale of low pressure diagrams, by experiment	1 in. = 11.65 "
Indicated pressure high pressure diagrams, lbs. per sq. in.	51.57
Indicated pressure low pressure diagrams, lbs. per sq. in.	8.46
Water pressure during time in which diagrams were taken, lbs. per sq. in.	76.7
Revolutions per minute do	13.73
Pressure on high p. piston reduced to equivalent on pump piston, lbs. per sq. in.	48.18
Same on low p. piston	35.51
Sum of the two	83.69

$$\text{Efficiency of pump} = \frac{76.7}{83.69} = 0.91643$$

Some other observations and results deduced from them are added.

Duration of trial, hours	15.1
Average revolutions per minute	13.62
Steam pressure above atmosphere, lbs. per sq. in.	89 5
Vacuum, inches of mercury	27.4
Barometer, " "	29.81
Temperature of engine room	79°
" " feed-water	119°
" " flue	358°
Total quantities:	
Lbs. of coal	3,633
" ashes	223
" combustible	3,410
U. S. gallons pumped per 24 hours, calculated from pump capacity	4,401,272
Per cent. of ashes	6.14
Hourly quantities:	
Lbs. of coal	241
" " combustible	226
Lbs. of coal per sq. ft. of grate	8.38
" " combustible per sq. ft. of grate	7.86
Lbs. of coal per sq. ft. of heating surface	0.236
Lbs. of combustible per sq. ft. of heating surface	0.222
Lbs. of feed water	2.437
Evaporation:	
Lbs. of water per lb. of coal, at observed temperature & pressure	10.13
Lbs. of combustible at same	10.79
Lbs. of water per sq. ft. of heating surface per hour at same	2.39
Lbs. of water per lb. of coal from and at 212°	11.49
Lbs. of water per lb. of combustible from and at 212°	12.24
Lbs. of water per sq. ft. of heating per hour from and at 212°	2.71
Power:	
Net horse-power (calculated from water pressure)	135.55
Indicated horse power $\frac{135.55}{0.91643}$ =	147.91

Lbs. of Coal and Water per Horse-Power per Hour.

Coal per net horse-power	1.78
" " indicated horse-power	1.63
Feed-water per net "	17.98
" " indicated horse-power per hour	16.48

In addition to the experiments already detailed, the amount of water drained from the cylinder jackets was measured for a period of two hours in the case of each jacket, giving as the hourly discharge in lbs.:

From high pressure jacket	112
" low " "	168
" both	280

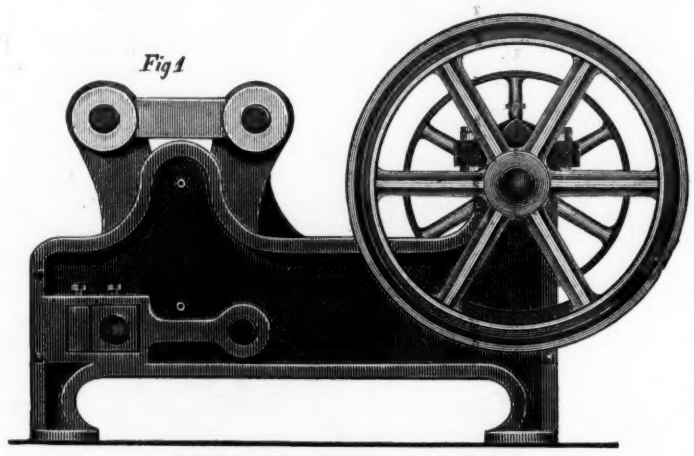
At a late meeting of the London Institution, Prof. Ayrton delivered a lecture on "The 100,000th of a Second," in which he introduced a variety of instruments and appliances by which small intervals of time, and the greatest velocities are now measured with an accuracy that was believed to be impossible not many years ago.

The engineer of a steam fire engine in New Haven has invented an attachment for his engine house alarm clock which, at appointed hours, opens feed-bins and lets the regular amount of food all prepared into the horses mangers. The principle can be applied to the feeding of barn stock.

Buchanan's Universal Crusher.

We herewith illustrate an ore and stone crusher, which possesses some new and valuable features. This machine is designed for the purpose of reducing fragments of minerals, varying in size from three inches, or more, down to dust. Referring to Fig. 2, the reader will readily understand the construction of this crusher. It consists of two heavy cast-iron frames *A*, which are held together by two heavy bolts at each end. The two jaws, *B* and *C*, are made to oscillate upon fixed centers or bearings, which are formed by two pins passing through their lower extremities and the frames. The tops of these jaws are held a uniform distance apart by means of the connecting links *H*.

Fig 1



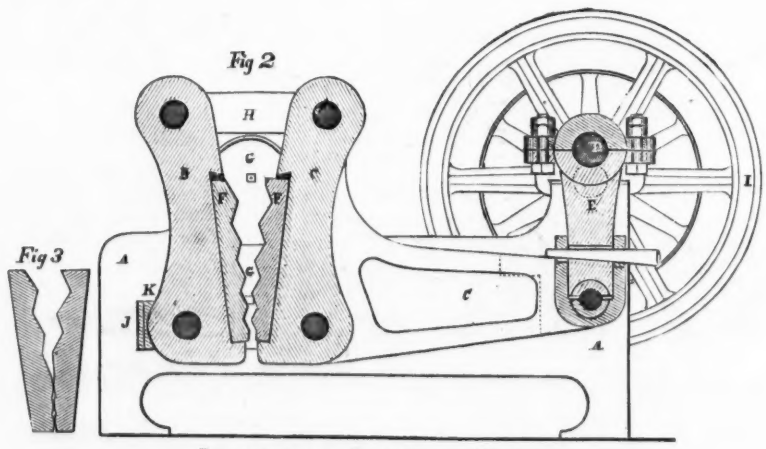
Buchanan's Universal Crusher.

Motion is communicated from the shaft *D* to the jaws *B* and *C*, by means of a pitman *E*, which, instead of being constructed as shown in the engraving, has a yoke of heavy round iron which passes around the lower end, and through the top box, thus does away with the two bolts shown, besides the strap and key. Both top and bottom bearings are easily adjusted by this device.

A steady motion is secured by the two heavy fly-wheels *I*, which are counter-balanced and placed upon the shaft *D*. The changeable crushing plates *F F*, are made of the hardest and toughest kind of chilled iron, and are so arranged that they may be removed and others inserted by taking out the keys at the top without disturbing any other part of the machine, or doing any fitting, a hammer being all the tools necessary for the operation.

Fig 2

Fig 3



Longitudinal Section of Crusher.

The fragments are prevented from escaping at the sides of the crushing plates by the side-plates *G G*, which are in two pieces, not only to avoid breaking, but in order that the bottom part may be renewed without replacing the whole plate, as it wears out more rapidly than the top part. These plates are also made of chilled iron. The reader will observe that the crushing plates are arranged with angular projections which move up and down opposite each other, thus rolling or tearing the stone or ore into fragments.

The crushing plates, as represented in Fig. 2, are for coarse work, while those in Fig. 3 are for pulverizing or reducing minerals to a powder.

By the construction of this machine, it will be seen that the greatest motion of the plates takes place at the top, gradually growing less, until a simply rubbing and almost parallel motion is produced at the lower part of the plates. Coarse and fine work may be done with the same machine, it being only necessary to change the plates.

The pin which passes through the bottom of the jaw *B*, is supported at the ends by the movable blocks *K*, which may be adjusted by means of the wedges *J*. These blocks and wedges are held in place by set screws which are not liable to get out of order, and, at the same time, furnish an efficient device for adjusting the plates.

The fact is well understood that the tensile strength of many minerals is less than one-tenth of their resistance to compression. The motion of this machine was designed with a view of subjecting the minerals to a combined torsional and crushing strain at the same time, thus overcoming the great waste of power which is lost in the application of a direct crushing strain. The minerals are broken, by this motion, in the line of the least resistance.

The strain required to crush the minerals is, by this motion, confined to that part of the frame which lies between the bearings of the two jaws, which is made extra strong by the application of a solid connecting link which forms a part of the casting, as shown in Fig. 1.

The strains which will be brought to bear upon the different parts of the machine seem to have been well provided for.

This machine is double acting or, in other words, both the upward and downward movement of the crank produces a crushing force upon the mineral. The top part of the plates *F F*, act as breakers becoming finer and finer, passing out at the bottom of a uniform size, and with astonishing rapidity.

The journals on the shaft and crank are large and well proportioned, all of which are fitted with hard anti-friction metal. The frame of this machine being made in sections can be taken apart making it easy to transport, which is a great advantage in mining countries. A "breaking-cup" is attached to the pitman, which is strong enough to do the work required; but should a piece of iron or any other hard or foreign substance accidentally get between the crushing plates, the breaking-cup will give way, which prevents injury to the other parts of the crusher. The part referred to can be replaced at a small cost, thus rendering it a valuable improvement.

The Universal Crusher is built by C. G. Buchanan, at the Union Iron Works, Rockaway, N. J., who will answer all inquiries concerning it.

Practical Draughting.—Colors, Cabinet-Saucers, Brushes.

BY T. P. PEMBERTON.

India Ink has been named "the draughtsman's color." Certainly, to the mechanical eye, a well-lined or finely shaded drawing of machinery has great attractions. Formerly, when photography was in its infancy, the expert draughtsman was frequently required to produce pictures of machinery that were lined out to a scale, and then shaded up and tinted by means of brushes and colors. Some such very beautiful pictures of beam and horizontal engines, locomotives and pumps are yet to be seen, although they were executed years ago by draughtsmen who spent many days in their execution. These pictures can be ranked with the finest oil or water-color landscapes; they exhibit accurate study of light and shade, and a finish that resembles the most elegant photography.

Such pictures are the draughtsman's highest art; the artistic eye, the steady hand, besides the closest and most patient application are all required for their production.

If the quality of India ink should be good for line drawings, it certainly must be of the finest when used for shading with the brush. As generally used now, it is procured in sticks and rubbed down in a circular cabinet saucer or oblong slab. Fig. 25 represents the form of Winsor & Newton's

best India ink. Fig. 26 represents "a nest of cabinet-saucers" which allow different tints and colors to be mixed for use at one time, one saucer acts as a cover to the other—keeps dust out and prevents rapid evaporation.

Fig. 27 shows a Patent Ink covered slab in which the ink is rubbed on an inclined plane and the ink allowed to flow into a small circular basin, from which it is dipped up by the lining and bow pens. For line drawings ink should be jet black. Common writing inks are not used for architectural and mechanical drawings. Liquid India ink, that is ink already mixed for use, can now be procured in small bottles, and there is now in the market a really fine article to be had in this form, which is a handy one and liked by most draughtsmen. The colors required by mechanical draughtsmen are few in number, but should be of the best quality. Besides India ink the following water-colors are required:

1.—Neutral tint.
2.—Prussian blue.
3.—Chrome yellow.
4.—Gamboge.
5.—Raw Sienna.
6.—Carmine.
7.—Vermillion.
8.—Venetian red.
9.—Sepia.
10.—Indigo.

FIG. 25.

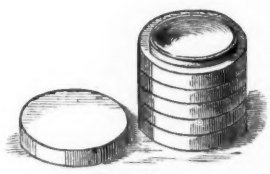


FIG. 26.

These water colors come in hand cakes. Fig. 28 represents a whole cake, and Fig. 29 a half cake. Winsor & Newton are among the most celebrated manufacturers of water colors.

Certain colors and tints represent different metals and materials. With the exception of Prussian blue for wrought iron and steel, there are no colors which can be properly termed technical or conventional colors. Every draughtsman has his favorite mixtures or tints, and a colored representation of cast iron in Washington, D. C., may be a very different tint to that used by a draughtsman in London or Paris. For instance: India ink, Prussian blue and a little crimson lake will, if mixed in proper proportions give a good gray for unfinished iron castings.

Neutral tint by itself is used for the same purpose; also India ink and Indigo, Curved surfaces of finished or polished cast iron are, in a shaded drawing, left white; plane surfaces are faintly tinted with indigo. Wrought iron is indicated by light Prussian blue. Steel by a darker shade of Prussian blue. Brass can be represented by chrome yellow, or a combination of gamboge and crimson lake. Copper, brick, stone, wood, leather, and other materials are represented by colors which resemble theirs. Imitations of oak, pitch pine, and walnut, for instance, can be given by representing the grain and color of those woods. Something more will be said on these technical colors in a future number under Tinting and Shading. Camel hair brushes, as represented by Fig. 30 are suitable for ordinary coloring. Sable hair brushes are more elastic, and more expensive, and should be reserved for the finest work. The former are termed "Double Camel Hair Wash Pencils." They have metal, not quill tubes.

The tubes holding the brushes are permanently secured to the handle. One brush is used to hold color and the other to hold water. As the points of the brush are what are worked with, the points should be fine ones, as shown in the annexed engraving.

Pulleys and Belts.

BY CHAS. J. HAGUE.

When a line of shafting is to be driven from another line in a room above or below, the placing of the shafts and pulleys is a matter of no small annoyance to some, and a few words to the point may be acceptable. One of the most important factors to be looked to in locating a pulley, is the *direction* in which the pulley will deliver the belt. When a pulley once gets a fair hold it will "pull" for all it is worth, but in order to get a fair hold, the belt *must be delivered* in a proper manner from the *other* pulley. Bearing this in mind then, the main thing to look to in placing shafting for a "quarter turn" belt, is the manner in which each pulley delivers the belt to its mate. The shafting must be perfectly level, and the pulleys, as near as can be, of the same size. Then if the center of the *delivering faces* of each of the two pulleys is brought to touch the same plumb line, the belt will "track" in good shape. The positions of the pulleys may be slightly changed from the above to suit certain conditions, such as short distance between centers of the two lines, or great difference in diameter of pulleys; but if the shafting is placed with reference to the plumb line, a very little adjustment will suit most any case. The best results, however, will be obtained when the pulleys are of the same size, and not greater in diameter than twice the width of belt, the distance (vertical) between centers of shafts being not less than 3 feet for every inch in width of belt. When the distance between centers comes within 18 inches for each inch of belt width it don't pay to use such a belt. It will not be out of place to remark, that the two lines of shafting may be at any angle (horizontal) when the plumb line principle is made use of, though with an acute angle the direction of revolution may be reversed.

Some one has said that idler pulleys are "a poor excuse for poor engineering," and, perhaps, with *some* justice; but, if we attempt to draw too severe a line in the matter, we may find ourselves in the very box that Mr. Emery was trying to lecture the graduating class out of. While we are making our plans, and covering a great deal of valuable property with our manufactory, in order to rigidly adhere to certain formulæ, somebody may overstock the market with the very goods we have in mind to make, by making use of an establishment perhaps a few degrees further down the mechanical scale, but arranged to meet all demands. Right here is the place to remark that successful engineering is that which, without unnecessary delay, comprehends the extent of resources at hand and applies them in the best manner to suit the ends in view. But let us return to "idlers." It is sometimes necessary to either carry a belt under a timber or cut away the timber, and the timber may be in a place that forbids the idea of introducing an element of weakness. All that remains, then, is to place a good-sized idler pulley so as to steer the belt clear of the timber or other obstruction, even though it may be the "tight" side of the belt. There is certainly no very great objection to carrying long belts on idlers, or, under some conditions, employing an idler on the "slack" side of a belt to steady it and hold it to the pulleys, or, where the belt is comparatively near the floor, to use idlers to loop it up, as it were, thus forming a passage way at a point that would otherwise be obstructed. If a belt is overloaded, it is certainly very poor engineering to endeavor to make it drive by forcing an idler hard down on its back, and, before such an extreme is resorted to, it will surely be cheaper, in the end, to remodel the arrangement of the shafting and place things in a more favorable position.

The transition from belting and idlers to pulleys is both easy and natural. Pulleys having come up for a word, the first idea that presents itself is that we see, by far, too many pulleys disproportionately small for the work they are expected to do. A belt, to work to any advantage at all, must have *high velocity*. To attain this, pulleys of large diameter must be used. Horse power, to use a conventional term, is a certain number of "foot pounds" developed per minute; and as foot pounds are simply pounds of pressure or strain multiplied by velocity in feet, it follows that the greater the speed the less will be the required strain to produce any certain H.P. This minimum of strain brings a few blessings with it, viz.: reduction to lowest terms of pressure on shafting, and consequent reduction of friction, both from direct pressure and from springing that would occur under heavier pressure. The light pressure also prevents the oil from being forced out from between journal and bearing. The large pulley necessary to high belt speed, presents a greater value of surface for holding the belt to its work, and thereby a narrower and (here the economy begins to appear) cheaper belt may be used.

There are an almost endless number of conditions, resulting from the pulley question. The writer has repeatedly witnessed the breaking of shafting, from excessive cross-strain caused by over-tight belts, and has seen the breaking prevented, oil saved, power gained, and repairs rendered unnecessary by increasing the size of the pulleys. The shaft not only suffers, but the belting and lacing come in for a share of affliction. Where small pulleys are used, and the belt is as taut as a "fiddle string," it is often necessary to secure the ends of the belt by an over-lapping patch, laced or riveted; whereas by employing proper sized pulleys, the belt may be held by the ordinary manner of lacing.

The principle of foot pounds is no doubt the correct one to apply to belt speed and pulley sizes, but it may be more convenient to some to look at the question in the light of leverage. With a shaft running at, say, 200 revolutions per minute, it will certainly be easier to turn it by means of a 4-foot lever (pulley radius), than by one only two feet long; but the pulley circumference, multiplied by 200, gives the feet of travel per minute, and this result, multiplied by the pressure required to keep the shaft up to speed, will exhibit the foot pounds expended per minute to run the shaft.

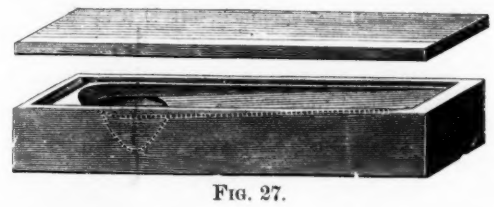


FIG. 27.

FIG. 28.

FIG. 29.

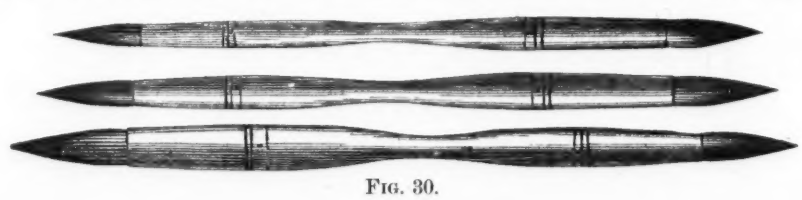


FIG. 30.

Boiler Proportion and Construction.—Smoke-Burning Furnaces.

BY WM. H. HOFFMAN.

The first smoke-consuming furnace was designed by Papin about the year 1780. His method was to force the smoke downward through the fire by a centrifugal blower. The Franklin stove, for domestic purposes, was constructed on this principle, though much simplified, the trouble in starting or lighting the fire prevented its general use.

Mr. Watt, in 1785, patented a device for preventing smoke, by which he placed the coal in a conical tube, upright in the brickwork of the boiler, just back of the furnace door, and passing a current of air through the furnace door to support combustion. By this arrangement, the gases evolved from the coal by the applied heat were caused to mix with the air, and passed over the ignited fuel and thus consumed. This method, however, was relinquished by the inventor, as the coal caused great trouble by caking, or forming a concrete through which the air would not pass.

Mr. Watt then adopted the wide dead-plate between the furnace door and grate bars, where the coal was first coked and then pushed on the grate bars. Mr. Wm. Thompson, in 1796, took out a patent for burning smoke by admitting air just behind the bridge wall. Then, in 1821, Mr. Murray, of Leeds, designed and patented his improvements in smoke burning. His plan was to pass the smoke through a tube furnished with a throttle valve, which valve was opened by an attachment to the furnace door, and closed by a vane wheel which was moved by the currents of air passing through the tube, into the furnace. The operation was simple, for when the furnace door was opened and a quantity of coal put on the grate, the throttle-valve is opened by its connection with the furnace door, and a sufficiency of air enters, but the entering air by turning the vane slowly closes the valve as the generation of smoke diminishes, so by first making a proper adjustment the induction of air can be perfectly regulated.

Pritchard, of Leeds, soon after proposed to accomplish the same results by means of a piston in a cylinder falling by gravity. About the same date Mr. Prideaux patented his method, where the air entered at the furnace door through a series of Venetian lattices, which opened when the furnace door was opened, and closed gradually by the slow movement of a piston in a cylinder affixed to the door. The air was passed between a collection of thin metal plates attached to the furnace door. By this means the air was heated, and the door cooled.

Mr. John Steel, of Dartmouth, designed a smoke-burning grate and furnace in 1819, but it was only perfected in 1822. He used a circular revolving (mechanical) grate in connection with *two* boilers; the smoke was consumed under one boiler and the gases (after mixing) under the other. Cutler's plan, soon after, was to light the coal on and passing downward consumed the smoke completely; but the appliance was inconvenient. Mr. Moult tried to revive this method by using a large dead plate in connection, by which the flame was passed over the coals, but no great success attended his efforts.

After this Mr. Losh, of Newcastle, patented a combination of double furnaces; the smoke from one of the furnaces was made to pass into the ash pit of the other with the atmospheric air. The furnaces were fired alternately, one being bright while the other was smoky.

But the most practical of all the numerous patents were those of Mr. John Bourne. One of his plans was to arrange the furnaces in pairs, with an opening between each pair of furnaces, so as to permit the smoke from one to pass through a pipe fitted at the furnace-mouth into the ash pit of the other furnace, and ascending through the bars of this furnace the smoke was consumed.

Mr. Bourne then used a perforated bridge wall in two different forms, one an upright casting covered with fire-clay for protection, with openings through which the smoke passed and was met with the incoming air, the other was the inclosed grate bridge wall, making two separate fires, one in each furnace; the smoke from the first or front set of bars was passed downward through the coals on the inclined grate bridge wall, and, of course, was entirely consumed. This was the best method of all the early inventions.

I will speak of the more recent devices for burning smoke hereafter.

Enlargement of American Steel Works.

Under date of Jan. 24, Mr. A. L. Holley writes as follows to Mr. Swank, Secretary of the American Iron and Steel Association:

In reply to your letter of the 23d instant, I give you, very gladly, all the facts I have concerning the enlargement of our steel works.

First, in regard to Bessemer steel works: The Albany & Rensselaer Iron and Steel Works have lately increased the capacity of their vessels and blowing engines, which should add 12 or 15 per cent. to their ingot output. They have nearly completed a heavier blooming train, 31½ inches, to replace the old one, and also are adding a 10-inch, a 14-inch, and an 18-inch train. The Bethlehem Iron Company is just completing an additional converting plant, which will more than double its ingot capacity. It is completing a 24-inch steel train, and is building a heavier engine for its 21-inch merchant-steel train, which will increase its capacity. The Pennsylvania Steel Company is about completing a three-vessel Bessemer plant, which will more than double its ingot capacity. The Cambria Iron Company is about enlarging its vessels, so as to add 10 or 12 per cent. to its ingot capacity. It is also getting out drawings for a new rail-mill, to be completed as soon as possible. It is building another 20-foot blast furnace for Bessemer pig. The Edgar Thomson Steel Company is just now enlarging its vessels and adding a cupola, which should increase its ingot output 10 or 15 per cent. The Joliet Steel Company is about putting in new cupolas, vessels, and other Bessemer apparatus; also a spare hydraulic engine and a spare blowing engine, which should add 20 per cent. to its ingot capacity. The Vulcan Steel Company, after standing idle a year or more, is just blowing in, after extensive repairs, which should add at least 100,000 tons to the ingot capacity of the United States. I do not know what, if any, additions are going on at Scranton, Cleveland, South Chicago (Union), or North Chicago. I believe Scranton is about to double its ingot capacity by erecting a second Bessemer plant.

Second, in regard to open-hearth steel-works: The Cambria Iron Company has lately started a pair of 15-ton Pernot furnaces, but the plant is still incomplete. When the Krupp washer, now building, is in operation, the ingot capacity will be at least 40,000 tons per year. Two similar furnaces are contemplated, to be begun when these are got into full work. The Bethlehem Iron Company has nearly completed a pair of 12-ton open-hearth furnaces, which with the Krupp washer, or with the Siemens direct process contemplated for preparing the material, will give an ingot capacity of about 30,000 tons per year. The Pennsylvania Steel Company is, I believe, going to increase its open-hearth capacity. The Springfield Iron Company, of Illinois is about to start one 15-ton Pernot open-hearth furnace, and is building a second and a Krupp washer, which will give 40,000 tons ingot capacity, intended chiefly for rails. This plant will be followed by another, like it or larger, when the first is well started. The Nashua Iron and Steel Company is about adding a second 12-ton to 15-ton open-hearth furnace. The Otis Iron and Steel Company is adding a fourth 12-ton open-hearth furnace. Spang, Chalfant & Co., Pittsburgh, have commenced building a pair of 10-ton Pernot open-hearth furnaces and a Krupp washer, also a blooming train and other trains to make and work up 25,000 to 30,000 tons of steel per year. Park, Bro. & Co. are about starting a 10-ton opening-hearth furnace. The Albany & Rensselaer Iron and Steel Company, the Joliet Steel Company, and the North Chicago Rolling Mill Company intend, I believe, to erect open-hearth works.

Third, the open-hearth works started during the past eighteen months are B. Atha & Co., Newark, New Jersey, one furnace; A. Kloman, Pittsburgh, one furnace; Hussey, Howe & Co., Pittsburgh, one furnace; Shoenberger & Co., Pittsburgh, one furnace; Anderson & Co., Pittsburgh, one furnace; Otis Iron & Steel Company, Cleveland, one furnace; Mitchell, Tranter & Co., Covington, Ky., one furnace; Burgess Iron & Steel Company, Portsmouth, Ohio, one furnace. During that time the St. Albans Iron & Steel Company, Vt., has restarted its furnace, and the Roane Iron Company has got its two in regular operation.

Fourth, the Pittsburgh Bessemer Steel Company, Limited, is erecting a Bessemer plant of about 75,000 tons ingot capacity. I hear rumors of other Bessemer works in contemplation, but I cannot make any authoritative statement.

Proportioning Machinery by Text-Book Rules.

BY EGBERT P. WATSON.

The sizes for various parts of machines are supposed to be arrived at by some abstruse calculation. That is the supposition on the part of many of the men in the shop who follow the drawings. Those who make the drawings do not entertain this view, for they know better; but they do not undeceive the men on that score, but lead them to believe that nothing is more necessary for designing a steam engine or lathe than an accurate knowledge of the higher mathematics. There are no rules which apply, generally, to all machines, and none which apply specifically that can be safely used if the conditions vary slightly; but there is *a* rule which all men use to a far greater extent than they would be willing to acknowledge. That is the rule of thumb, and it is a useful one if a man has a good thumb. For example: A customer wants a special machine made, which has an entirely new combination of forces and mechanical powers. The man sketches out his idea and the draughtsman

The Star Paper Cutting Machine—See Page 5.

embodies it. It is built. Tried in the shop before being sent out, it is broken where it was thought amply strong. Who is to blame? The boss says the man who calculated the strains is; but the man shows him that the section (by the books) has an ample margin of safety. The boss says he don't care what the books say—"take the patterns back into the shop and have pieces put on here and there;" which, being done, the result is satisfactory. This is the rule of thumb, and a great rule it is. Sometimes it is not possible to introduce greater strength of parts, for the reason that the machine has been "beautifully" designed in all its proportions, and cannot be changed anywhere without practically rebuilding the whole of it. Then there is a pleasant time in that shop for all concerned, especially if the boss is of a dyspeptic turn. I have seen chaos come again in a draughting-room, and a distribution of material which presupposed the arrival of an earthquake, under such circumstances.

I have seen a four-inch steam piston for ordinary use with a rod one inch in diameter, and many others have seen the same thing. Now, a rod one inch in diameter, so far as strength goes, would be ample for a tensile strain of forty tons, more or less, and how is it possible to get forty tons, or anything like it, on a four-inch steam piston? Cast iron, says a note book, has a tensile strength of so many square inches; but what kind of cast iron? This material is as diverse in its constituent parts, or character to resist fracture, as any other metal, varying, as it does, from 18,000 to 38,000 pounds per square inch of section. Must one analyze every casting before he employs it in machine work to know how much to put in a given piece? Of course this is manifestly absurd, but the query is based on the proportions laid down, in some text books, for sizes of certain parts of machinery.

Again, the text books advise us that the strength of cast crucible steel is upwards of 240,000 lbs. per square inch of section. Where this piece of information was derived from I am puzzled to know. Cast steel highly carbonized possesses tensile strength, according to the degree of carbonization, up to a certain proportion, but the ordinary merchant steel of commerce has no such strength. The steel of which hay forks (pitchforks) are made possesses, in an eminent degree, high tensile strength and elasticity, yet the breaking strain of this is about 100,000 lbs. only, and ordinary machinery steel—such as is sold at 7½c. per pound—from 70,000 to 80,000 pounds per square inch. It is true that isolated instances are on record where cast crucible steel has been brought to show a tensile strength of 240,000 lbs. to the square inch, and over that; but it is not steel to be found in the rack of the smith's shop, or anywhere else, except to order. Such steel is of no use in shop work.

"Experience teaches," says the copy book—and the rule of thumb, elsewhere alluded to in this article, is simply experience.

The wider the base the firmer the superstructure," is an axiom generally correct; but supposing a man on horseback extends his legs as far as possible sideways, thus widening his base, does he sit firmer in his saddle? He wobbles. The Tay Bridge was calculated to resist certain strains, and the builders supposed they had allowed margin enough, but the result shows that they did not err on the right side.

In citing these cases, and drawing parallels, I do not wish to be understood as having any personal grudge against an arithmetic. That noble book existed before I was born, and will, doubtless, after I am gone; but I am willing to place myself on record as caviling at set rules for all cases, or adopting handbook practice as reliable for every-day work.

Materials vary so much in strength, according to their mixture or the locality from which they come, that no general rules can be laid down, so far as mere strength of material goes.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * There is one peculiarity about Sackett's management which I do not remember ever having mentioned to you. He imposes specific duties with specific margins on every man around the place. His organization in this respect seems to be perfect. It is well understood that a performance which one thinks of shirking, becomes burdensome when accomplished. Being burdensome the accomplishment is generally slighted. It is not the laborious work of life which we generally complain of, but the little unconsidered things which, contrary to all anticipation, we find must be done, and as no one else has seen fit to do them, we must take hold ourselves, and often on the most inopportune occasion. Under these common circumstances these details, often of vital importance, are generally treated in a slip-shod, slovenly manner.

* * * * Sackett seems to have taken a broad and comprehensive view of this subject, and the smooth even running of his shop, under every emergency, bears testimony to the fact that he has provided for all duties, definite and contingent, in a masterly manner.

* * * * By Sackett's plan he saves himself the annoyance of being appealed to on a hundred different occasions each day, to settle some matter clearly and definitely within the province of his superintendent. His superintendent is not called upon to do work which half a dozen foremen may shirk, and so on down. If there is anything to be done around Sackett's shop, it is somebody's business and duty to do it, and as a consequence it gets done, and at once, and easily, and willingly, and thoroughly.

* * * * Sackett has no rules and regulations in his shop. He finds it pays to use and keep men who can understand their duties when the line is defined. He never discharges a man for the commission or non-commission of an act; but the man who develops an unfitness for his place steps down or out on the first occasion. If a man should smoke in Sackett's pattern shop that man would stay in that pattern shop no longer. If Sackett saw no other place to utilize the man's value he would let him go entirely; not for smoking in the pattern shop, mind you, but on account of the disposition and unfitness developed by the act. If Sackett's foundry should burn down he would discharge the night watchman, not for allowing the foundry to burn, but for being an unreliable watchman.

* * * * But to return to Sackett's system of duties. As I have probably told you before, his shop is hardly a manufacturing establishment, though its proprietor is, in my estimation, a born manufacturer. Most of his work is of the general kind; in short, he owns and operates a machine shop.

His tools are the best I have ever seen in a shop. I might give the names of the half dozen tool builders whose products have met with the approval of Sackett's most excellent judgment, but if I did I would be accused of puffing. I think, however, that the very existence of a tool in Sackett's excellent shop is an advertisement for its builder.

* * * * This reminds me of the fact that Fetlock, a builder of machinist's tools from other people's patterns, lately laid down a copy of the American Machinist, and asked: "Who is the Chordal who is always advertising Brown & Sharpe and those other men?" And this again reminds me that Chordal is a machinist keenly appreciative of all that is better and more useful in connection with his craft; a machinist who, as long as he lives, will be alive to the importance and position of such leaders as by their skill and energy develop products which help us forward in the age, and which give us the

second blade of grass; and a machinist who will be the first to observe and the first to welcome the tenderest shoot which may spring from a seed planted and nourished by Fetlock.

* * * * To return to Sackett. That Sackett's tools are good is the result of his care as much as the builder's skill. Most of them are old, but not too old. Sackett knows just when to make money by throwing an old lathe or planer into the scrap pile. You will find a chap working on a lathe in Sackett's shop, who works on regular work the same as the rest. But if there are repairs on shop tools required, this man does it without delay or formality. If any lathe in the shop bores tapering, it is not the fault of the man who runs it, or the fault of the man who made it, or the fault of the owner, or foreman of the machine shop, or foreman in the foundry, or of the casting cleaners. It is the fault of this one man whose business it is to see that lathes bore straight, and as a consequence none bore tapering.

No man can plead that his tail-spindle does not move in line with live spindle, or that the live spindle is not in line with the V's. It is this man's business to keep things of this kind in first-class shape. Sackett has found such a course profitable; and if this man fails in his well-understood duty in a single instance, some better man will have that place. He won't leave the shop, but he will have to part with the dignity attaching to that special position.

* * * * Examine closely some of the little things about these tools. The dead spindles fit in their places. Centers fit in their places. Chucks and face-plates fit. Live spindles fit their boxes and bear well. The foot end of live spindles is in shape. Cones fit and are in balance. No back gears run with three teeth broken out. Change-gears will all go on their places, and there are feathers to hold them. Good solid workman-like feathers, not pieces of tenpenny nails. The proper wrenches are on hand. The lead screw has got a thread on it at the end where it is used the most. The lead screws are straight and don't worm the work when the feed is on. No change-gears are lost. The carriage clamps will do proper work. The steady rests have no broken jaws and no odd bolts. Face-plates are renewed when played out. Centers are long enough to work with. The frictions in the apron act all right. The cross-screw is not worn out. The tool posts can be moved in their slots without pounding. The tool-post screws are not split at the ends, and no old set screws are found in tool-post doing temporary duty year after year. Hand-cranks are in balance. Apron-screws have fair slots in them, and they can be got out with screw-drivers. The feed-worms have threads on them. Feed-racks don't have to "gum it" on account of lost teeth. Rack pinions ditto. Gib screws can be turned, and there is no paper behind worn-out gibs and shoes. There is not an inch of lost motion in the feed works. The quadrant-bolts are not odd ones, and the crownage on the cones is in the right place.

The planers will work square both across and down. The feed-pawls are in order and will feed. Not once in a while when they feel like it, but all the time. The down and angular feed can be used. It is all there and in perfect working order. The screws are in good shape, and the tool clamps are perfectly operative, and there are good wrenches fitting on good nuts and heads. The housings are set square and solid. The V's are always kept in good shape. If they are sprung or cut they are not sworn at, but are immediately refitted entirely. The lower boxes are in good shape, and so is the running work. The dogs are good dogs and the shifting work does not shake and wiggle all over the shop. When a planer makes a stroke it follows it up with another stroke. Start one of these planers and it will run till you stop it. The reversing is not a matter of doubt. It is decisive and certain, and can be depended upon as happening within a foot of the same place every time.

Planer chucks are kept squarely dressed and in good shape generally. Planer centers have all their parts present and in order. You can use them without repairing them.

Bolt cutters will act. There are no broken die blocks, nor broken levers, nor broken jaws. They get broken, but get replaced the same day. Milling machine arbors, set true with the feed and the cutters, don't drag.

Drill presses have their spindles square with the tables and bases, not only in the central position, but in all positions. The feed work is as good as new, for it was made new not long ago. The spindles fit just right, and the belts will stay on. Shaping machines will feed every time; the stroke can be changed as well as in a new machine; there is no slack in the down screw; and—wonders of wonders—the work it does is square.

Slotters are always in condition to do their best. You can use all the feeds the machine has. The tool bar fits in its place; the clamps are in order, and the feed shafts are straightened when bent.

The spindle in the Cotting drill fits solidly, and the machine will keep on doing the work you start it at.

The Keyseating machine will hold its cutters, and the crank-pin can actually be moved in its slot.

The screw machine may turn one job tapering, but it must then be squared up instanter. The turret is useful at each point. The chuck is neat and solid and kept so, instead of shaky and chawed up. The tool parts can all be used, and all the movements of this old machine are kept as good as new.

* * * * All the machines in the shop are kept in perfect condition, not by particularly careful use, or nibbling cuts, or other tender treatment, for Sackett don't waste much sympathy on weak tools, but by prompt and substantial repairing. To read the list you would think the honorable chancellor of repairs, hereinbefore mentioned, would be kept busy, but the truth is you never can catch him at this kind of work. There is precious little of it to do if it is done right and in time.

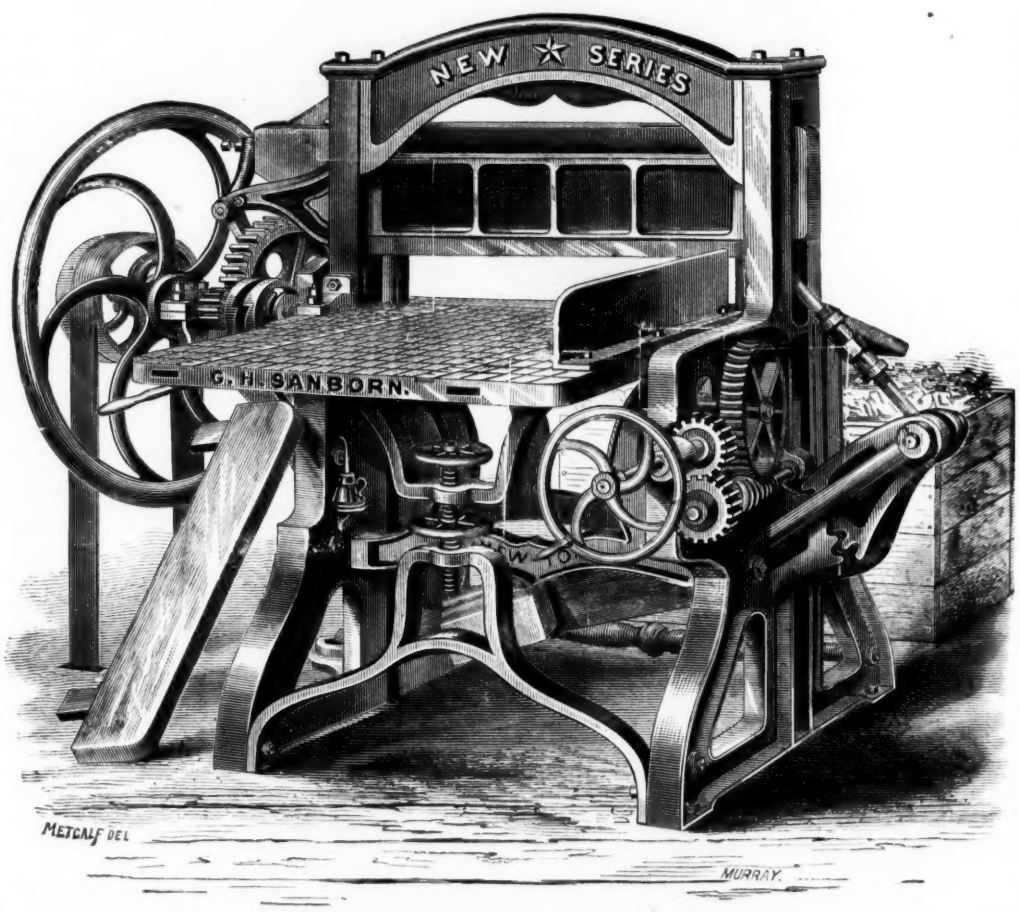
* * * * Sackett, one day, explained to me that he put this work into a man's hands and got it done. His foreman never need concern himself about the matter. He himself, of course, had nothing to do with the man; the foreman was his boss; but the man had a duty which it was expected he would do without either prompting or officiousness.

* * * * When I commenced this letter I intended to tell you something of Sackett's plan, but I have wandered off on to one of the details of the plan. Some other day will do, and then I may tell you that when there is something to receive in Sackett's shop, there is a person to receive it, and when there is something to ship, it is somebody's easy duty to ship it, and when there is something to order, there is somebody to order it. A thing is not delayed on account of some factotum being harassed with a thousand duties, undefined but still accepted, and there is no vast army of loafers with a single duty.

Sackett's place is run with less men than any similar shop I ever saw, and each man has work enough to keep him employed without harassing him. No man complains of excessive burdens. One can work for Sackett in the daytime and sleep o' nights. If any man lays off to fish, or lies down to die, another man knows his work and no interruption ensues. I have known of patterns being made in a shop the second time, because some man who carried the whole shop in his head had gone into the army.

* * * * Very respectfully,

CHORDAL.



THE NEW SERIES PAPER CUTTING MACHINE.

The Star Paper Cutting Machine.

An important peculiarity of this machine is the moving fulcrum secured by the toothed end lever working in a curved toothed segment, by which great power and equalization of power are obtained. A still greater increase of power is obtained by attaching the connecting-rod to the knife-bar near the link-pin, instead of at the end of the knife-bar, by the aid of the toothed lever.

Notwithstanding the small number of revolutions required to be made by the wheel, it is claimed that the latter loses none of its power in operation. By means of the peculiar form of brake employed the knife can be stopped instantly in any position, whether descending, cutting or rising after the stroke, and immediately after stopping it (the knife) returns to the top to a position of readiness for work, without dangerous rebound or interference with the power in starting the machine. By this means an important saving of time and labor is secured.

By the adjustable link-boxes at each end of the machine, the knife is readily adjusted to any thickness of paper or to any loss in grinding. A marked feature of this machine is the endless chain working over two straight grooved drums, whereby breakage and tangling of chain are avoided. This will be found especially valuable in cutting heavy work.

These machines are made extra strong in all parts, each piece being adjusted to meet every probable or possible strain that could be suggested by long experience. The inventor and manufacturer is Mr. Geo. H. Sanborn, 25 Beekman St., New York, or 77 Monroe St., Chicago, of whom further particulars may be obtained.

Castor Oil for Leather Belting, Hose, &c.

Considerable experience in the care of fire-hose warrants us in recommending castor oil as the best possible dressing for imparting flexibility and preserving the leather from rot and mould. While the generally recommended neats-foot oil becomes rancid after a while, castor oil remains sweet and unverdigrised. The best method of application to hose is internally by means of a small force-pump; the sections lying in a drip-trough which returns to the oil barrel or can the oil which has passed through the pores or seams. This system affords an excellent means of testing the hose. The oil should be slightly warmed, and a small proportion of bees-wax may be added.

To leather belting, castor oil gives durability, flexibility, and *clings* without glazing.

For harness, shoes, etc., give the leather all the castor oil it will drink in.

Rats do not gnaw castor-oiled leather.

Improved Lubricant.

Two open boilers, made of tinned sheet iron, were put upon two coke furnaces of equal intensity, but the bottom of one of the boilers was coated with the grease outside, so as to be in immediate contact with the flame, whereas the other was not so coated. The former began to give off steam in a quarter of an hour, and the latter not until half an hour had elapsed; whence it may be inferred that the grease increases the conductibility of the metal, so that with a given quantity of fuel more water is turned into steam. A brass lubricator, of cylindrical form, filled with the grease, was then plunged into the water in the coated boiler, and almost immediately minute particles of the lubricant began to issue from a small hole in one end, rise to the surface, and gradually spread themselves over it. This was to show the application to the interior of a steam boiler for preventing incrustations, 3 grammes (about 1½ drachms) being used for each horse-power. The grease is also carried along by the steam into the cylinders, rendering any other lubrication unnecessary. Notwithstanding the cooling effect produced by the lubricator, a large body in proportion, the water in the coated boiler bubbled violently in an hour from the time of its being placed in the fire, whereas the one not coated did not boil in an hour and a half, when the experiment stopped.

A portion of the grease was wiped off from the bottom of the coated boiler and thrown on to the fire, when it immediately flared and was consumed. The tin bottom was as bright as before, but that of the other boiler gave evidence of the action of the fire. This was to show, on a small scale, that boiler plates exposed to the action of the fire do not become burnt. And, indeed, this fact follows as a natural consequence of the other point established, namely, the increased conductibility given to the plates. Those who witnessed the demonstration were most astonished to see—that a stick dipped in the grease made marks on the hot sides of the boiler and furnace, as distinct as lines with a drawing-pen, and which did not run together, as they would have done if made with ordinary grease. So far the experiments have been most conclusive, fully bearing out the official certificate of the Spanish government; and it will be interesting to watch the result of a continued application to steam boilers on the scale of actual practice.—*Iron.*

A Shifter for Cone Belts.

We illustrate herewith a belt shifter which certainly seems to be one of the "useful" little things. Shifting cone belts when the counter shaft is but ten or twelve feet high is a simple matter, but when we come to the lofty shops of modern construction the case is different. The most skillful man, after many efforts to get the belt in place, is glad to resort to the ungraceful ladder or pole.

This device is a cheap simple attachment designed to fit most any where, and by its use, the longest and tightest of cone belts are as easily shifted as an ordinary belt on a loose pulley.

The device consists of a lower bearing or step which clamps, without any drilling, to the bed of a lathe or other machine. In this step rests the lower end of a piece of gas pipe whose upper end may fit in a hole in a board nailed to the ceiling joist. The position of this pipe will be readily understood from the cut. A handle is fixed on the lower part of the pipe, and near the upper cone a lever is fixed, in which slides a jointed belt shifter. By this simple device the lower handle gives complete control of the belt which may be instantly placed upon either step of the top cone. The parts furnished by the makers, the Niles Tool Works, of Hamilton, Ohio, consist of the lower step with its clamp, the handle, and the top shifting lever complete. The pipe is to be common rough pipe simply cut to a length. Half an hour's time will serve to "erect" the device under most any possible circumstances. Different sizes are made for different widths of belt.

Standard Cylindrical Gauging.

At a recent meeting of the Franklin Institute, Mr. George Richards read an interesting paper on *Standard Sizes in Cylindrical Fitting*, which was published in the "Journal of the Franklin Institute" for January. We make the following extracts:

The question that has called forth this paper is, what relation shall the sizes of holes in machines bear to standard measurements? or, in other words, shall holes be made above, exactly to, or below standard sizes?

In order to cause the argument to be more readily followed in entering into details, it will be proper to call attention first, to the conditions that must exist in any practical attempt to produce parts exactly similar. Different classes of manufactured products call for more or less uniformity in their parts. The controlling element, in most cases, being the destruction of the cutting edges, coupled with slight inaccuracies in the working details of the mechanism actuating the tools.

There is a defined limit to this matter of making parts duplicate and interchangeable in machines, based upon conditions so numerous that no attempt will be made to point them out here. Even when satisfactory results are arrived at, the sizes of duplicate parts can at best be only an approximation to some arbitrary or standard size, but should at all times be within some defined limits, the degree of accuracy established for the work being an exponent of this.

For example, let us suppose that a variation of one hundredth part of an inch is permissible in a certain class of work; in that case an inch, as expressing a size, could be one inch plus one two-hundredth, or one inch less one two-hundredth part of an inch, and yet be regarded as a duplicate of a standard inch, in that particular instance. In making standard gauges, guaranteed to be uniform to the one ten-thousandth part of an inch, as compared with original standards, the gauge may be larger or smaller than this original to the extent of one twenty-thousandth part of an inch. Were it possible to adjust the gauges to the one-millionth of an inch there would still remain the same conditions, in so far as approximating a uniformity in sizes.

This variation, then, represents the change which tools may be permitted to undergo and yet remain in use for a specific purpose.

It will now, it is hoped, be granted that it is a matter of much importance to arrive at some very definite conclusions about the relation that the sizes in machine fitting should bear to standard sizes. It has been pointed out, that with proper appliances for making the holes, they become the basis in carrying out a system of uniform sizes. Should the implements for finishing the holes be adjusted at first with an allowance made for their wear, to make the holes larger or exactly to a standard size hole?

The difference in the two cases is more than would at first be imagined, and in actual practice is of sufficient moment to warrant the assertion, that even with similar standards in each shop throughout the country, there cannot be said to exist any uniformity in the sizes of their finished product. The difference in the results will at all times be double the limit of accuracy that is assumed in fitting. In one case the variation in a one inch hole would be from 1.01 inches to 1 inch while in the other it would be from 1 inch to 0.99 inch, the difference in comparing the results together, being really one-fiftieth of an inch.

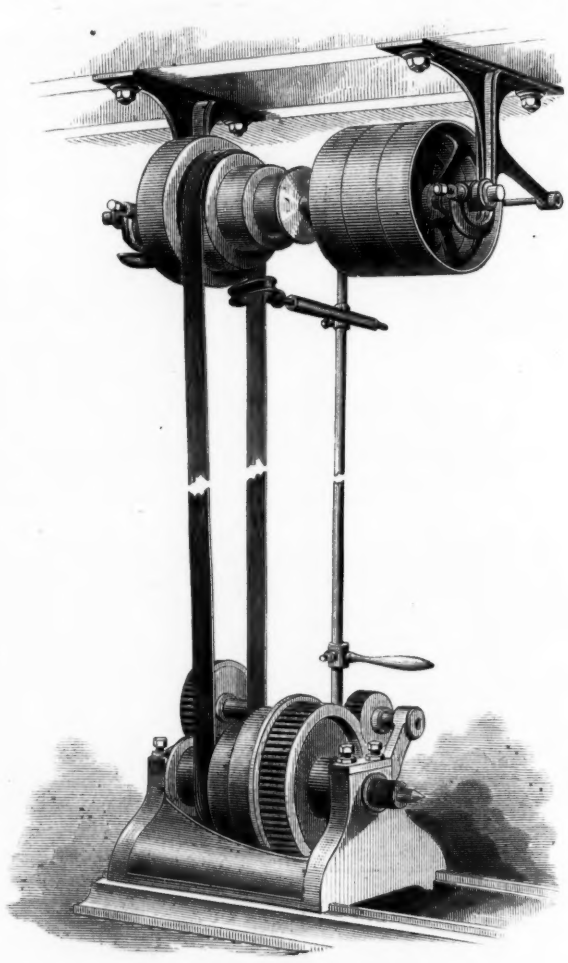
It will now be well to consider what should be the proper basis, in attempting to arrive at any definite conclusions on the subject.

Some of the different forms of standard gauges used in determining sizes in fitting are exhibited to assist in the matter.

The nature of the surfaces on a pin and ring gauge permit of their both being very nearly the same size. One ten-thousandth of an inch difference in either would make a marked change in the fit. To illustrate this, an example of two gauges with this difference in size is presented for inspection by the members. It would require perhaps a thousandth of an inch in even good fitting to produce the same apparent change in a shaft and hole.

Inasmuch as the close fitting of gauges cannot be carried into practice for this reason, either the *internal* or *external* gauge must be assumed as a shop standard.

Everything pertaining to the duplications of standards requires that the external gauge or a length standard be assumed as a basis. The standard lengths of Great Britain



A Shifter for Cone Belts.

adopted by our government, are bars with points, the outside dimension being the standard length.

In reproducing duplicates, measuring points are brought in contact with the ends, and the distance between them assumes the form of a gauge for that purpose, but not of a standard length.

Referring now to the interchange of different forms of standard gauges, the length standards are represented by pin gauges, the corrective gauge disks, and the "heel," as it is generally called, of the fixed caliper gauge, while outside measures for transmitting these lengths are represented by the measuring machine, the ring gauge and the fixed calipers.

The latter implements indicate a standard size plus two contacts, or in the case of the ring, of a continuous contact.

The amount of surface contact becomes of much moment in the fitting of standard gauges, owing to the nature of the surfaces and the density of the material employed. The distance measured between the points of a fixed caliper gauge is less than the internal diameter of a ring gauge indicating a similar size, because of the small amount of surface in contact in the former. Again, the internal diameter of a cast iron ring gauge must be greater than one of hardened steel, each appearing to fit the same over a cylindrical gauge. This difference is even more when both are fitted to a pin gauge of cast iron.

From these few examples it will be understood that the duplication of gauges is based upon assuming outside dimensions as the standard.

For these reasons it has been thought best to recommend that in fitting, the size of the holes should be above standard sizes enough to show a contact with a standard size shaft similar to the apparent fit of the gauges with one another.

To refer again to the variations in duplicating parts, as representing only an approximation at best, the different degrees of fitting must now be brought to bear on the matter.

Even if holes are assumed to be made uniform, the size of cylindrical parts must be varied to produce the different contacts referred to in the gauges.

In practice, fits are divided generally into three kinds: first a driving or forced fit; second a close contact or exact fit, and, third a fit loose enough to permit of the surfaces being lubricated by the ordinary means.

To now bring the three conditions that have been explained together: the standard gauges in their various forms; the variation that must occur from wear of tools to form holes, and the different grades of fits employed in practice, it would appear that to suit these conditions most favorably, the slight variation permissible in the holes, compared with a standard size shaft, should represent the fit described as a close one—neither a loose or forced fit Compared with the gauges now, this fit would show a similar contact with them, the fixed caliper going easy over the shaft and the "heel" of the gauge entering the hole apparently with a similar contact of the shaft. If the fit were a forced one, the shaft would be larger than the gauge, and if a loose fit, smaller than the gauge. Provided the cylindrical parts of machines were prepared in this manner, without reference to the holes, the variations that must be made in their size to fill the conditions of the different fits, is so much more than the variation that should be permitted in the holes, that practically no difference would be noted, whether the size of the hole is at one extreme or the other.

Letters from Practical Men.

TRANSMITTING POWER.

Editor American Machinist:

Sir —I have noticed, with interest, the remarks in the issue of the 24th inst of your valuable paper with reference to transmitting power to a distance, and shall be glad to see some of your correspondents take the matter up in earnest, as I believe the time is not far distant when we shall have either air or water-power supplied to our works and manufactories in somewhat the same manner as we now have gas to our houses.

The idea had often suggested itself to my mind of utilizing the power of the rise and fall of tides in rivers, by accumulating some of that enormous amount of power which is daily lost, and using it to compress air to be afterwards transmitted to power consumers; and I have, for some time, been studying the design of some economical and practical arrangement to carry this out. Some of the power of large waterfalls might also, I think, be well applied to the same purpose, or to supply water at a moderately high pressure. I have put down machinery in this country, working under similar circumstances on a small scale, with the greatest success, utilizing the power of falls for compressing air, by transmitting the power, through the aid of turbines or water-wheels, to air compressors near the spot, and conveying the compressed air, in some cases, through several thousands of yards of iron piping (sometimes over hills), to work machinery.

I have also tested the variance of the pressure under different circumstances, and found that, when the pipes are carefully jointed and put down, the loss is almost *nil*.

In some places on the continent (Europe) the power of the flow of rivers has been applied, by being transmitted through ropes and other appliances to works in the *immediate* neighborhood, with comparative success; and in one of our own provincial towns here a company was started, a few years ago, to supply water at a high pressure to factories and warehouses in different parts of the town, the water being pumped from the river into a reservoir from which it is supplied to the consumers, under pressure obtained with the aid of dead weight accumulators; and I have every reason to believe that this is a thorough practical success, and I mention it not merely to show the practicability of transmitting power economically to a distance, but also that a step has been taken in the right direction.

It will be readily understood that with either air or water-power the risk to warehouses and works from fire is very greatly reduced.

I prefer air to water on account of difficulties which may arise with the latter in frosty weather, and also on account of the many uses to which air can be applied after completing its principal object, not forgetting that steam engines already put down in different works could with little or no alteration be run with air.

I am, Sir, your obedient servant

Philip J. Le Gros.
113 Victoria St., Westminster.
London, 2d Feb., 1880.

HOW TO LOSE MONEY SAVED.

Editor American Machinist:

Dear Sir:—We have read Chordal's letters with a great deal of interest. They have incited some discussion as to how mechanics spend their money. He understands workingmen far better than many who wield a ready pen; but Chordal stops short, just when we want him to go on.

He says: "Money burns holes in men's pockets. They put it where you can't get at it." Now, Mr. Editor, the question is, where is the place to put it?

The experience of the workingmen of this city has been a bitter one. They have toiled hard beside the planer, or at the bench, have been careful of their pennies, frugal at home —some of them own their homes, others are paying for a house in yearly installments. Wages were good. They saved something over and above the amount due on their yearly notes, and put this sum in a bank "to provide for a rainy day." One morning we heard the newsboys crying, "Full account of banks busting." True enough, they tumbled down one after another, like card houses, leaving the workingmen in a pretty fix.

The results have been mechanics have been fleeced right and left, until there is no wool left.

In one shop, amongst 150 men, of whom but a part were saving, there was sunk in the "busted" banks more than $5,000. Some of them had in $500, while others who had but just begun saving, lost less than $20.

Chordal understands full well, that the small amount received as a 10 % dividend vanished like the early dew. Of this sum of money frittered away, workingmen received

no benefit. They have been waiting three years for a paltry dividend that amounted to less than the honest interest of their money, put into Government hands would have done. The balance, we presume, will be "gobbled," like all the funds of busted banks are, in lawyers fees, court fees, and the sharks that are continually on the alert for just such affairs as these.

Under such circumstances is it any wonder workingmen spend all their money in a little enjoyment?

When Chordal can advise us where to put our money so that thieves, in the shape of defaulting cashiers, speculating directors, who desire to get rich on the earnings of working men, and thieving lawyers cannot touch it, then we will again open an account, and when Chordal runs for President of the United States, we will vote for him.

I am, sir, yours truly,

Chicago, Feb. 11th, 1880. NORMAN.

THE BRACING OF BOILERS.

The Editor of American Machinist:

Your issue of January 31st, 1880, has an illustration of the crown-bars and braces of the fire-box of a locomotive steam-boiler; the object of the illustration being to show a method of fastening the top ends of the vertical braces to the shell of the boiler, instead of by crow-feet as usually practiced, your correspondent confidently asserting, that had such an arrangement of fastening been adopted in the case of the "Lehigh," "an explosion would never have taken place under the same circumstances—" no doubt, meaning that an explosion would never have taken place from deterioration, resulting from the arrangement of the fire-box bracing.

Since the arrangement of bracing and fastening, shown in the illustration, is precisely such as has been recently somewhat prominently advocated in your journal, and relating as it does to a very important feature of locomotive-boilers, it is much to be hoped that the present opportunity to show the merits or demerits of such an arrangement will not be lost.

Therefore, in the interest of the vitally important and responsible business of *boiler-making*, I do, without hesitation, assert that such a method of fastening the braces to the shell of the boiler would prove more fatally destructive than the more general practice of fastening with crow-feet, and would have the effect of forcing the lines of deterioration lower down on the straight sides of the fire-box—a weaker part of the boiler.

It is evident from the language of your correspondents that, to some extent, at least, they are alive to the fact that unequal expansion and contraction of steam-boilers is the active cause of these fatal lines of deterioration. A little reflection should convince them further that lines of deterioration will at all times coincide with the natural lines through which destructive forces will be transmitted.

Let those who advocate lines of vertical braces connecting the crown-bars rigidly with the shell, explain how such braces are capable of accomplishing the object for which they were intended, viz. supporting the crown-sheet.

It is a well known fact, in connection with locomotive boilers in particular, that the stay-bolts towards the top and ends of fire-boxes have but little durability, breaking after but comparatively little use. So trouble some is this that expedients have been resorted to to indicate any stay-bolt that breaks, such as using tubular stay-bolts, etc., which will allow a jet of water to pass through them as soon as they break, thus warning the attendant that the bolt has broken.

The breaking of stay-bolts in the part of the fire-box named is due to the extensive and frequent deflections to which they have been exposed. These deflections must have resulted, mainly, from the unequal degrees of expansion and contraction of the inside and outside fire-box sheets; this is an incontestable practical illustration and proof that, when hot, the crown-sheet of the fire-box is higher up in the boiler, or closer to the top of the shell than it is when the boiler is cold, and that this relative variation is comparatively extensive, being sufficient to produce the deterioration and ultimate destruction of the stay-bolts. The natural deduction from this reasoning is: that any vertical braces connecting the crown-bars rigidly to the shell, and adjusted, as they must always be, to their respective positions when the boiler is cold, with the object of holding up the crown-bars under steam-pressure, are incapable of accomplishing that object. Instead of holding up the crown-bars they absolutely constitute the most powerful agent within the boiler, aiding the steam-pressure to crush the crown-bars down. In practice, so severe is this conflict between the crown-bars and the shell that deranged and broken braces and where the bracing, etc., is excessive, as in the case of the "Lehigh," the destruction of the shell itself is every day practically shown.

Crown-bars alone should constitute the support of the crown-sheet. Neither theoretical reasoning or practical use can show any destructive influence involved in their use, no circumstance limits their dimensions so as to prevent the use of bars of self-sustaining proportions. If crown-bars 4″×½″ were suspected of being too weak, what circumstance prevents them being increased either in depth or thickness, or both, to the extent necessary to secure the requisite strength to be self-sustaining? The increase in the weight of the material would be nearly the only extra cost incurred, which, as compared with the cost of vertical braces, crow-feet, etc., even supposing such bracing efficient, and without considering the inconvenience of such bracing in any boiler, should always decide any discreet boiler-builder in favor of using crown-bars alone.

Cleveland, Ohio, Feb'y 2d, 1880.

W. H. THOMPSON,
Mech. Eng.

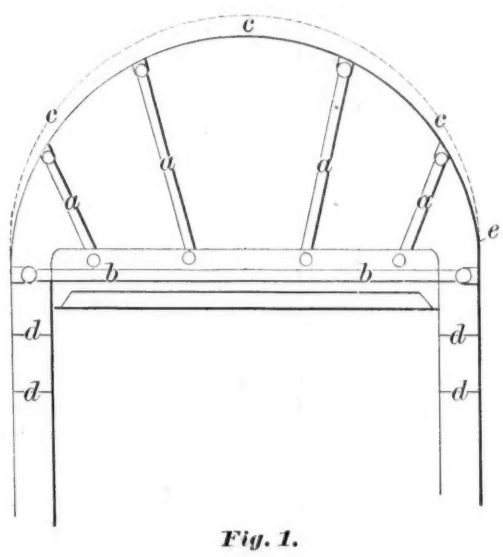


Fig. 1.

Fig. 2.

TRIANGLES—AND HOW TO MAKE THEM.

In an article on "Practical Draughting," in No. 5 reference is made regarding the triangles, which is scarcely sufficient to enable the novice to make them very readily and accurately, which may be desirable by many.

The triangles of 30°, 60° and 90° may be formed, as shown in the annexed diagram, by drawing the line *a b*, with a straight edge, and next, with a pair of dividers, or, if these are not at hand, a small stick may be made as shown in Fig. 1, the pins *c c*, serving the same purpose as the points of the dividers; or, a piece of wire may be pointed and bent, thus, ⌐ .

From the point *d*, Fig. 2, (on line *a b*,) space off any distance, say *e*, and the segment of a circle *f*, of the same radius; thence, from the point *e*, strike the arc *g*, and the point *h*. Thus the necessary points are established, and it is only necessary to draw the line from the point *d* to where the arcs *f* and *g* intersect, and from this point to *h*, when the required triangle will be formed.

The triangles of 45°, 45° and 90° can be formed by "setting off" a distance from *i* to *k*, equal to that from *i* to *d*; connect the points *d* and *k*, and the triangle is obtained.

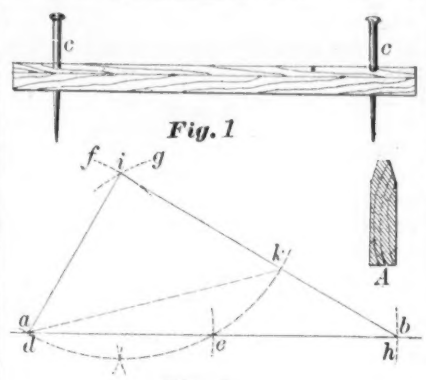


Fig. 2.

When the article on which the triangle is to be marked off is not large enough to allow the establishment of the point *h*, strike an arc from *i*, through the points *d* and *e*, letting it run about one-half this distance beyond *e*; bisect the arc between *d* and *e*, and lay off the result at *k*, from the point *e*, as shown, and the same result is obtained.

Those who can obtain it, can scarcely do better than to use hard rubber as a material from which to make the triangles; although, if well made of ebony or maple, they will answer all practical purposes. The open pattern is preferable to the solid, on account of exposing part of the drawing to view, thereby lessening the liability to make mistakes; and being made of wood, they are light and inexpensive and preferable, on that account, except where *extreme* accuracy is required, to those made of metal, which have the disadvantage of being expensive, heavy, and more or less liable to soil the drawing or paper.

Unless the wood from which they are made is well seasoned and of fine, straight grain, they are sometimes liable to warp slightly; but this can generally be obviated by properly selecting the wood, which should be very dry and free from moisture when the triangles are being made or cut from it. Having trued up the edges to conform with a good straight-edge, the triangles should next be tested by measuring the sides; the distance from *i* to *d*, and *i* to *k*, should be equal in the triangle of 45° and 90°, and in that of 30°, 60° and 90° the distance from *d* to *h* should be twice that of *d* to *i*, and the square edges should come in line with the lines as formed in the diagram, or a square.

This having proved all correct, the edges should be slightly beveled as shown at *A*.

As these triangles are used considerably as rulers for drawing small, straight lines, the edges of those made of wood should be varnished with black shellac varnish, and after the first coat is dry, it should be rubbed down with very fine or worn-out sand paper, and another coat applied. This will enable the edges to retain their accuracy for a great length of time. MATT. A. BECK,

Feb. 5th, 1880. Waterloo, Iowa.

Over-Staying Boilers.

BY FRANK C. SMITH.

The explosion of the locomotive *Lehigh*, which has attracted so much attention in the mechanical world, and which according to many experts ought to have done almost anything else than explode, appears to have fallen from the path of boiler rectitude from mal-construction—over-staying. That is, it is possible to over-stay a boiler and make it "too safe" seemingly, a fact which engineers are beginning to recognize. The designer of the "Lehigh" appears to have thought (with a great many other leading R.R. M.M's) that by tying the crown-bars to the shell overhead, thus causing the stays to take the strain, he would have a job like that wonderful "one-hoss shay" that never would give out. A little thought will show that these stays, even for the purpose intended, are unnecessary. The shell being of a circular shape, is the strongest possible shape it could have been put into, and if the crown-sheet were properly supported by crown-bars and covered with water its safety is unquestionable. The writer is personally cognizant of some sixty locomotives in which these stays never existed, not one of which exploded, barring one in which the engineer had wedged the safety-valve lever, and all of which were in service at twenty-five years of age.

The *Locomotive*, published by the Hartford Steam Boiler Insurance Co., of January 1st, has the only *explanation* of the explosion. The "Lehigh's" fire-box was tied from the crown-bars to the shell overhead by some 50 stays (*a a a a*, Fig. 1), and also by transverse stays (*b b*) between the crown-bars. Assuming that the fire-box was heated to 1,500 degrees, and the shell overhead to a temperature of the steam—about 350 degrees, it is clear that the extra expansion of the fire-box due to its higher temperature over that of the shell, was transmitted by the stays *a a a a* to the shell, which was forced upward and outward, as shown by dotted line *c c c*, in an exaggerated degree.

The tie-rod *b b*, connected on a line with *p p*, Fig. 2, evidently held the outside sheet firmly, acting as a fulcrum for the stays *a a*, to push against, causing a short bend (at every cooling off of the boiler) and fracture at *e* in both figures, which finally resulted in the explosion. It is evident that if the stays *a a a a*, had never have been introduced the explosion would never have occurred. It is a fact that the top stay bolts *c c*, Fig. 1, are always the first to go, and that the extra expansion of the fire box is accountable for it, can hardly be denied. The lesson to be learned from the "Lehigh's" explosion is not to tie the fire-box down by any more stays than is absolutely necessary to retain it in its position and shape. The "Lehigh's" explosion recalls one of which the writer was almost a spectator. A locomotive had been accidentally fired up and left with a heavy fire for three hours after the boiler had been blowed out. The M. M. said it didn't injure a piece of iron to heat it red-hot in the forge and let it cool off, and consequently the fire-box was not injured. A few new stay bolts drew the worst "puckers" back into shape, and the engine was in service continually for some eighteen months after, when one evening, with a gauge pressure of 110, while standing still, she turned a complete summer-set, a side sheet of the fire-box having blown in. During the eighteen months she was in service after the "burning" she leaked continually at nearly every stay bolt in the fire-box, as well as the fire-door ring, repeated caulking affording only temporary relief. The fire-box was only four years old, I believe, and the engine a wood burner; so, outside of the burning, it was practically nearly as good as new. There is no parallelism between the heating of a piece of iron in a forge and the heating of a fire-box. If the M. M. had confined his piece of iron so that expansion could not have occurred, he might then have been convinced that the fire-box was in bad shape. It is fair to assume that if the overheating did not injure the fire-box, the fact of its being tied to the outside sheet from which it was striving to tear itself with all the force of expansion did injure it, by starting every stay-bolt and innumerable minute fractures—starting points for a weakness that ended in disaster. That the fire-box was injured by over-heating was shown by the stay-bolts pulling out of the inside and remaining in the outside sheet. The M. M. was one of those *eminently* practical men, unfortunately so often found in charge of matters that require an equal admixture of theory. As far as *his* light went he did the square thing by the Co., for he saved them, at the time, the expense of a new fire box, but ended in wrecking the entire engine, or, as the half cooked victim remarked, "it was a saving at the spigot and a wasting at the bung-hole."

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NEW YORK, MARCH 6, 1880.

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Formation of a National Association of Mechanical Engineers.

In our last issue we referred to the prospective organization of a National Society of Mechanical Engineers. A meeting of prominent engineers from eight States of the Union was held at the office of the American Machinist, Monday, February 16th, upon the invitations of Prof. John E. Sweet, Prof. R. H. Thurston, and Mr. A. L. Holley. Much enthusiasm was manifested as to the success and advantages of such a society properly organized. The following mechanical engineers were present at the meeting:

Prof. John E Sweet.....Syracuse, N. Y.
Charles T. Copeland.....New York.
A. L. Holley.....New York.
Charles T. Porter.....Newark, N. J.
Charles E. Emery.....New York.
Prof. W. P. Trowbridge, of Columbia College, New York.
F. F. Hemenway.....Troy, N. Y.
Samuel S. Webber.....New York.
Wm. H. Hoffman.....Passaic, N. J.
Alfred R. Wolff.....New York.
Samuel Webber.....Manchester, N. H.
Henry R. Worthington.....New York.
Frank C. Smith.....Delaware, O.
M. N. Forney, Editor *Railroad Gazette*, N. Y.
A. B. Couch.....Philadelphia, Pa.
John Fish.....New York.
C. C. Newton.....Cleveland, O.
E. D. Leavitt, Jr.....Cambridgeport, Mass.
D. S. Hines.....New York.
Stephen W. Baldwin.....Yonkers, N. Y.
Wm. Lee Church.....New York.
Robert Grimshaw.....Philadelphia, Pa.
W. H. Odell.....Yonkers, N. Y.
Herman T. C. Kraus.....New York.
George A. Barnard.....New York.
T. R. Pickering, U. S. Gov't. Agent for Melbourne Exhibition.....Portland, Conn.
J. S. Coon.....Cambridgeport, Mass.
Egbert P. Watson.....Elizabeth, N. J.
George M. Copeland.....New York.
Lewis F. Lyne, of the American Machinist.

The meeting was called to order by Prof. Sweet, upon whose nomination A. L. Holley was chosen for chairman and Samuel S. Webber, Secretary. Letters from the following engineers were read, each regretting their unavoidable absence and expressing their earnest approval of the formation of such a society:

Chas B. Richards.....Hartford, Conn.
E. H. Parks.....Providence, R. I.
James W. See.....Hamilton, Ohio.
Ambrose Swasey.....Hartford, Conn.
Mr. Warner.....Hartford, Conn.
E H. Robbins.....Pittsfield, Mass.
John W. Hill.....Cincinnati, Ohio.
Edgar Penney.....Fitchburg, Mass.
John H. Cooper.....Philadelphia, Pa.
William Kent.....Pittsburgh, Pa.
Frank H. Pond.....St. Louis, Mo.
E. Lyman.....Lowell, Mass.
Chas. A. Hague.....Chicago, Ill.
J. C. Hoadley.....Lawrence, Mass.
F. G. Woodward.....Worcester, Mass.
William J. Williams, West Conshohocken, Pa.
Geo. H. Norman.....Boston, Mass.
W. Barnet Le Van.....Philadelphia, Pa.

An interesting and pointed address was delivered by Mr. Holley upon taking the chair.

He said: It is remarkable that a mechanical engineer society has not been organized before, for it underlies all engineering. However, it is better late than never, and more material and better methods of organizing are now known. Engineering is the science and art of utilizing the forces and materials of nature. This is done both by machines and processes. We expect to have the pleasure of laying this entire address before our readers next week.

After some discussion as to a suitable name it was decided to call the new association The American Society of Mechanical Engineers. A set of rules and by-laws was submitted and approved by the meeting. These, however, are open for revision before final adoption. The by laws set forth that the objects of the society are, to promote the arts and sciences connected with engineering and mechanical construction, by means of meetings for social intercourse and the reading and discussion of professional papers, and to circulate by means of publications among its members the information thus obtained.

The Society will consist of Members, Honorary Members, Associates and Juniors. Those admitted to the first two of these classes must be professional, mechanical, civil, military and mining engineers, and every regular member have been in the practice of his profession for at least seven years, not merely as a skilled workman, but as one qualified to design and execute engineering work, and must have been in responsible charge of work in his branch of engineering. Honorary members are those who have virtually retired from practice. An Associate must have such a scientific or commercial connection with applied science as will qualify him to co-operate with engineers in the advancement of professional knowledge. Juniors must have been in the practice of engineering for at least two years, or they must be graduates of an engineering school. The term "Juniors" has no reference to age, but to professional experience. Juniors are eligible to membership. Only Members and Associates are entitled to vote. Juniors can neither vote nor be members of the Council.

Nothing in the way of special privileges is to be accorded to engineers who do an office business, or to professors in technical schools, over those who as proprietors, superintendents, foremen, and designers, occupy responsible positions in the rounds of engineering duty.

The Society is also to include Chief Engineers of steam apparatus, who have attained proficiency in their respective branches, as well as the men engaged in various other kinds of mechanical work, who shall be deemed eligible by the Council.

Candidates for all classes of membership are to be admitted by a vote of all members and associates, after being recommended by the Council. Members and Associates pay an initiation fee of $15, and $10 per annum, dues, Juniors pay $10 initiation, and $5 dues. There are to be three regular meetings every year. The annual meeting is to be held in the City of New York, on the first Thursday in November, and the other two meetings at such places as shall be selected by the council.

The schedule for officers and Council is to be similar to that of the American Institute of Mining Engineers. There are to be a President, six Vice-Presidents, nine managers, a Secretary, and a Treasurer. The President, Secretary, and Treasurer, are to be elected annually, and the former is not eligible for a third term. Vice-Presidents hold office two years, and managers three years. The officers and managers together constitute the council.

A quorum of the Council consists of five, and a quorum of the society, thirteen Members and Associates.

The Council has the power to decide upon the reading of any paper before the society which may be received, also to order it printed. At each regular meeting the subjects to be discussed at the next meeting are to be announced. The reading of papers and the free discussion of mechanical subjects are expected to be of immense value to the mechanical industries of this country. As expressed by Prof. R. H. Thurston, the Society, if properly organized and conducted, will benefit our industries to the extent of millions of dollars annually. Of all the numerous Engineering Societies of Great Britain, the Institute of Mechanical Engineers is the most important and beneficial to the great manufacturing industries of that country. This Institute has been in successful operation in that country for over thirty years, but heretofore no national organization of the kind has been started in America.

Our constructive engineers have stood apart from each other to such an extreme that many of the most prominent engineers, well-known to each other by their works and reputation, have never had a personal meeting. We had the pleasure of witnessing a few such meetings at our office, February 16, upon which the cordial shaking of hands and expressions of mutual good will between rivals in business, constituted a gratifying feature. That the interchange of friendly greetings, face to face, and of practical ideas upon the problems of mechanical engineering will prove of inestimable value not only to the direct participators, but to our national industrial progress, there is no room for doubt. If the United States is eventually to surpass England as the "workshop of the world," no more potent agency can be brought to bear in producing this result than the successful operation of the American Society of Mechanical Engineers.

The following committee on nominations was appointed: Messrs. A. L. Holley, Prof. J. E. Sweet, H. R. Worthington, E. D. Leavitt, Jr., and Chas. T. Porter. The chairman will soon appoint a committee on Constitution and By-Laws, to report at the next meeting which is to be held in this city, April 7. The meeting just held was only preliminary, the object being to ascertain how the formation of such a society would be regarded. The enthusiasm with which the movement was taken up, makes it certain of success, and the meeting of April 7 will permanently organize the Society.

Some After-Thoughts.

If this week, pretty much all our fiddles play upon one string, the importance of the event chronicled must be our excuse. In American mechanical annals, the sixteenth day of February, 1880, should be a red letter day. Such an event as the birth of an *American Society of Mechanical Engineers*, under auspices so favorable, is one that does not occur every day or often.

Special notice should be given to the extent of the field that the new society may expect to cover. The address of the chairman of the preliminary organization outlined this admirably. The mechanical appliances that are required to make all mining operations possible, not only in opening and working the mines, but in treating and utilizing the ores; the mechanism employed in building and operating railroads, bridges, aqueducts, ships, telegraphs, etc.; the vast and diverse array of mechanical appliances required by all branches of manufacture, as well as the great variety of tools and appliances employed in constructing all these, are all included in, and form part of, the field to be occupied by the new society. It should not be forgotten that the proceedings thus far have been entirely preliminary; the men who join the organization at the April meeting will be the charter members of the society.

Necessarily, the preliminary invitations to such a movement must be limited, not only by the personal acquaintance of its projectors, but by the necessity of representing various localities. It was, by some, considered desirable that the prime movers in the organization should be, as far as possible, men who were not absolutely manufacturers. But the subsequent proceedings showed how readily trade rivalries could be overlooked or forgotten. The last drop of the curtain found one eminent engineer enthusiastically engaged in advocating the selection of his chief business rival for the presidency of the new society, upon the ground that his name would have a familiar sound in every machine shop in Europe, as well as every backwoods district of America.

Aside from the interchange of thought upon mechanical subjects, one great object of such a society is the better acquaintance of its members with each other. This idea was very happily expressed by one of the speakers. Alluding to a gentleman present as well-known to him through his reputation as the designer of one of the greatest pumping engines of the day, the speaker said that hitherto he had always thought of this particular engineer as having an immense walking-beam down the middle, with brass steps up the side. For the future, he should be able to mingle an accurate personal knowledge of the man with an abundant appreciation of his work.

It was a subject of general regret that, notwithstanding the part taken by him in initiating the enterprise of forming the new society, Prof. R. H. Thurston, was prevented by ill-health from attending its first meeting. It was his intention to be present, but a sudden cold, operating in conjunction with the ailment from which he had been suffering for the past year, defeated this hope at the last moment. However, his friends will be pleased to know that his general health is improving steadily, and that the relaxation and change of scene involved in his contemplated European trip, may be confidently expected to restore him to active duty in the autumn. Meanwhile, though absent in body, he will be present in spirit with the organization, which already owes so much to his counsel and assistance.

In the course of his short address, Prof. W. P. Trowbridge, of Columbia College, made a graceful allusion to the position of the technical schools in the line of mechanical progress. He said that the men in the schools could not originate the bright, new ideas that are constantly changing the aspect of mechanical matters. The men in the shops are the men who lead; the men in the schools must be content to teach the boys what they themselves learn in great degree from the men at the front.

In the interchange of sentiment, the absent were not forgotten; they could not be in such a meeting. Honored names were spoken, and were received with honor; but one of the expressions that stirred all hearts was the allusion to the workmen, the men at the vise, the planer and the forge, whose help it is that makes all engineering triumphs possible. The American Society of Mechanical Engineers will fail of its great mission, if it does not render a valued return to these untitled workers of the rank and file.

An Industrial School Wanted.

We have been requested, by the Consul-General of Nicaragua, Central America, Mr. Alexander Cotheal (one of the earliest subscribers to the AMERICAN MACHINIST), resident at 62 West 36th Street, New York, to give prominence to the fact that Nicaragua desires to establish an Industrial School for workers in iron and wood, under American management.

The Consul-General desires, as an essential preliminary to this step, correspondence with persons qualified to inform him as to the probable cost of furnishing engines, machinery and apparatus for a school of this nature, in which both hand and machine work will be taught; also information regarding the cost of such schools now existing in this country, with information regarding the salaries that competent instructors and foremen would probably expect to receive. As yet nothing definite has been decided upon by the Nicaraguan Government regarding the size or cost of the building, or buildings, in which the proposed school will be held, nor the amount of money which will be set aside for its support. The present inquiry is intended to supply data for this purpose.

We would suggest that it might be of advantage if competent persons would enclose plans of buildings that would be likely to be considered suitable, together with estimates for their equipment, as such action might lead to a profitable contract.

The Consul General states that the proposed school will probably be located at the city of Grenada; also that the climate is healthy, and living cheap.

As an interesting corollary to the above, the Consul General says the Nicaraguan Government are now putting up a machine shop for their first railroad, some of the machinery being already in position. The first locomotive ever brought into the country has just started to run.

We are informed by the Corliss Steam Engine Company that our notice that they were to enter an engine for competition at the Millers' International Exhibition is premature. They have been invited to exhibit but have not yet accepted.

The American Institute of Mining Engineers.

The regular meeting of the American Institute of Mining Engineers was held in this city on Tuesday evening, February 17th, the session to continue during the week. A number of interesting papers have thus far been read, some of which we hope to present to our readers in a later issue: Owing to the crowded state of our columns this week, we are unable to find space for this purpose. This organization is in a very flourishing condition, having a larger membership than any kindred body, numbering now, in all, 792 members, of whom 133 members and 19 associates were admitted during the past year.

John Richards.

A cable dispatch from Manchester, England, gives information of the decease of Mr. John Richards, who is well-known as an engineer, and an author of mechanical works.

He acquired his handwork experience in a large manufactory of wood-working machinery in Cincinnati, and subsequently came to Philadelphia, and became senior partner in the firm of Richards, London & Kelley. He was the principal designer of the many excellent wood-working machines brought out by this establishment. For a number of years Mr. Richards gave his personal attention to the introduction of wood-working machines into England, Sweden, and other European countries, and to him more than to any other individual belongs the credit of successfully introducing American wood-working machinery into Europe, and laying the foundation for the extensive and growing trade in that department which our manufacturers are now enjoying.

About two years ago he retired from the above firm and started the American Standard Tool and Gauge Works, in Philadelphia, which was subsequently merged into the Betts Machine Co., Wilmington, Del. While his son, George Richards, had charge of the establishment in Philadelphia, he gave his personal attention to the wood-working machinery trade in Europe, the firm being Richards & Atkinson, of Manchester, England.

Mr. Richards wrote several books on wood-working machinery and other mechanical subjects, all of which have had a large sale, and are regarded as authority upon the subjects treated. He also wrote extensively for technical journals in Europe. Our readers will remember a brief, but suggestive communication from Mr. Richards, upon the subject of Machine Nomenclature, which appeared in our issue of January 3d, 1880.

Business Specials.

Forty cents a line for each insertion under this head.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co., New York, or the author, Manchester, N. H.

Lathe Attachments for Milling Plane and Irregular Forms; Taps and Reamers fluted and Gears cut without removing from the lathe centers. For extended description, see AMERICAN MACHINIST, Sept. 13 and 20 issues. Send for circular to Wm. Main, Piermont, N. Y.

Models made to order; experimental machinery built; parts of models supplied. H. B. Morris, Ithaca, N. Y.

Light machinery contracted for. Slide Rests a specialty. W. C. Young & Co., Worcester, Mass.

See Christiana Machine Co's advertisement, next number.

Thorough instruction in mechanical drawing, practical drafting and studies relative thereto, given at schools or by private lessons. T. P. Pemberton, 249 Duffield Street, Brooklyn, N. Y.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) C., Catskill, writes: I have a horizontal engine, 12″ × 36″, it has a single D-valve. When it runs up to speed it makes 60 revolutions per minute. We have two boilers each 3 feet 6″×20 feet. We cannot get over 40 lbs. of steam, and have hard work to keep it there. We run one planer and saw, and one set of 4 feet stone. When we run all at once it will not run over 50 revolutions per minute. The man that made the engine says it ought not to run over 45 turns. Would we gain more power if we were to make the pulleys larger and run the engine at 45 revolutions? Do you think a ¾ cut-off would help any? *A.*—60 revolutions per minute is not any too fast to run the engine. There is no power in your pulleys. It is the cylinder of the engine that drives the pulleys. We would advise carrying higher steam, say, 85 or 90 lbs. to the square inch, (that is if your boiler is in a condition to stand the pressure). Put a cut off valve on the back of the main slide, and cut off the steam short enough in the stroke so that the mean pressure in the cylinder will be sufficient to do the work required.

(2) A. C. D., New Oxford, Penn., writes: I had a log turned 22 inches in diameter, which I sawed into lengths of 8 inches for chopping machine blocks. How can I keep them till next fall, and prevent them from cracking? *A.*—The blocks should not have been cut off the log until you wanted to use them. To give them two or three coats of varnish (or, better still, glycerine) might help them.

(3) Query, Brandon, Va., writes: A difference of opinion having arisen as to the amount of water in pounds evaporated by a pair of compound engines, will you settle the question, and also show your method of obtaining the result? Data, as follows, from indicator diagram of high pressure engine; diameter of high pressure cylinder, 42 inches; distance to point of release, 44 inches, including clearance (2 inches); mean effective pressure, 22.3 pounds per square inch; terminal pressure, 14 pounds per square inch; revolutions per minute, 50. *A.*—The data given above is scarcely sufficient to give an answer with anything like accuracy, besides we ought to have the diagram from which the above figures were taken. Approximately: 1385.44, the area of piston×44 No. of inches stroke×2 No. of strokes per revolution ×50 No. of revolutions per minute×60 No. of minutes in an hour×2 number of engines, and this product divided by 911×27.7 gives 28,999 as the number of pounds of water consumed per hour.

$$\frac{1385.44\times44\times2\times50\times60\times2}{911\times27.7} =$$

28,994 pounds per hour.

(1) D. C. B., Hannibal, Mo., asks: Please tell me what is the best material to use in case-hardening links, etc? *A.*—The animal charcoal used is composed of burnt horns, bones, hoofs, and leather. We are acquainted with parties who use leather only, considering it the best as it gives satisfactory results. In case-hardening the success of the operation depends more upon excluding the air, preserving a uniform heat, and getting the articles into the water without coming in contact with the atmosphere, than upon the kind of animal charcoal used. For other directions see AMERICAN MACHINIST for Nov. 8th, 1879.

(5) J. W. H., Champaign, Ill., asks: Please answer the following queries and oblige a reader of the MACHINIST. 1. How many "Bessemer steel" manufacturers are there in the United States, and where? *A.*—There are eleven manufacturers of Bessemer steel in the United States, beside a new one just putting down a plant. They are: Albany & Rensalaer Iron & Steel Co., Troy, N. Y.; Cambria Iron Co., Johnstown, Pa.; North Chicago Rolling Mill Co., Chicago, Ill.; Lackawanna Iron & Coal Co., Scranton, Pa.; Penn'a Steel Co., Baldwin, Pa.; Vulcan Iron Co., St. Louis, Mo.; Joliet Steel Co., Joliet, Ill.; Cleveland Rolling Mill Co., Cleveland, O.; Bethlehem Iron Co., Bethlehem, Pa.; Union Iron Works, Chicago, Ill.; and Edgar Thompson Steel Co., Pittsburgh, Pa. The new one is the Pittsburgh Bessemer Steel Co., Pittsburgh, Pa. 2. What per cent. of carbon do Bessemer steel rails contain? *A.*—Bessemer steel rails contain a different per cent. of carbon, which was ably discussed in a series of papers by Dr. C. B. Dudley, which were read before the American Institute of Mining Engineers, and printed in their transactions, Vol. 7. The following is recommended as the formula for the chemical composition of rails for the use of the Pennsylvania railroad.

	per cent.
Phosphorus, not above	0.10
Silicon, not above	0.04
Carbon, between 0.25 and 0.35 per cent. with an aim at	0.30
Manganese, between 0.30 and 0.40 per cent. with an aim at	0.35

Sulphur and copper—no specifications.
All other impurities, not more than traces.

3. Is the metal completely de-carbonized and then a % of carbon added, or partially de-carbonized? *A.*—In some cases the process of de-carbonizing has been stopped at a certain point during the process, by which the required amount of carbon is retained in the metal, but this is a delicate process, and is uncertain, except in the hands of a very skillful operator. We might say that the safest plan, and also the process practiced generally is, to entirely de-carbonize the metal, then add the amount of carbon, and other necessary substances, thus insuring a more uniform mixture. It is necessary in all cases to analyze the pig iron from which the steel is to be made, in order to determine what substances are in excess, also those required to be added.

MANUFACTURES.

Among other industries that have the "boom" that is so general throughout the country, few have been so marked as the increase of orders for steam pumping machinery. While at Holyoke last week we called at the works of the Deane Steam Pump Co., and found every department busy. The reputation of the Deane is such as to keep the manufacturing department busy on orders from every part of the world. Among recent orders is one for a large plant of mining pumps for Chili, another for the entire plant for a sugar estate in Peru, and still another for mining pumps for Mexico. This export trade, coming in with their constantly increasing home trade, taxes their works to their full capacity.

Nearly the required sum for a knitting mill at Fonda, N. Y., has been subscribed.

Bentel & Margedant (wood-working machinery), Hamilton, Ohio, are running along with very fair prospects, having all the work they can handle. The shops have recently been improved by the addition of new machinery.

The Cope & Maxwell Manufacturing Co., Hamilton, Ohio, are running about sixty hands on full time, and have work on hand for some time to come. They have under way a pair of pumps with a capacity of 1,000,000 gallons per day, which will be sent to Elmora, Colorado, for use in the mines. They are also building two large pumps, one of which will pump 1,500,000 gallons per diem, to be used in Connellsville, Pennsylvania. Four others of the same size are in the shops, designed especially for mining purposes in California mines. They report business as increasing and prospects most flattering. Their water-works trade is somewhat depressed, owing to the rise in the price of iron pipe, as this item is by far the most expensive in the construction of water-works. In other respects the increase in the iron market has helped their business.

The Bradley & Hubbard Munufacturing Company, of Meriden, Conn., have lately commenced work on a one hundred feet addition to their foundry; the Foster & Merriam Company are far advanced in two large additions to their works, and the E. Miller Company are contemplating a $40,000 addition to their already large factory.

The George H. Gilbert Manufacturing Company have raised the pay of their employees, both at Ware and Gilbertville, Mass.

The Dwight and Chicopee Companies of Chicopee, Mass., have advanced the wages of their employees.

Moore & Ames, of Bellows Falls, Vermont, are to build a paper mill in the spring. This mill is to be 135 feet long, 50 feet wide, with an L, 100 feet in length. A new woolen-mill is also projected at this village, to employ eventually 150 hands.

The Pratt & Whitney Co., Hartford, Ct., have 490 names upon their pay-roll, against 270 at the same time in 1879, and have work enough to keep all hands employed 13 hours per day. Deliveries are mostly upon domestic orders, but shipments are frequently made on foreign account. Of late, bolt cutters, milling and screw machines have been sent to Canada, and planers to India, lathes and four-spindle drills to England, and lathe chucks to Mexico. They have finished and delivered the fifty-eight Shaw stocking looms, upon which they have been at work for several months.

Samuel Sutton, Oshkosh, Wis., writes us: Trade is very good with us at present, in C. C. Paige's foundry. We have several engines to make, also water-wheels for parties that are building new mills, besides an unusual amount of job work. The boom has struck us sure, and long may she wave!

The Niles Tool Works, Hamilton, Ohio, are crowded with work, having orders sufficient to run 250 men for four months, night and day. At seven o'clock the shops are brilliantly illuminated with the electric light, an extra set of men put on and remaining at work until relieved by the day force. Two of their large boring and turning mills were recently shipped to Nottingham, England. There are now under way eight of these machines, weighing from five to ten tons each, which will be sent to different parts of the country. A car load of machinery was shipped the other day to Denver, Colorado. A pair of large hoisting engines weighing 40,000 pounds each are now being constructed for use in California mines. They have a large contract for fitting up machinery for the car shops of the Cincinnati Southern Railroad, and the A. & G. W. road.

The Stow Flexible Shaft Company, Philadelphia, have just supplied the Grand Trunk R. R. shops with their flexible shafts, to be used in drilling and tapping stay-bolt holes in locomotive fire-boxes, which has heretofore been done by hand.

A new company, known as the Ohio Iron & Steel Company, has bought the old Lowellville Furnace, near Youngstown, O., which has been idle for seven years past. It is to be rebuilt and put in order at once.

Nichols & Hines, hat manufacturers, Danbury, Conn., have set a tubular boiler with the Jarvis setting.

The Jarvis Furnace Co., of Boston, set over sixteen 100 H. P. tubular boilers for the American Linen Co., Fall River, Mass., last year. This mill has two large engines, and runs by steam power. Before changing, it cost $79.81 per day to run 80,200 spindles. They now run the same number of spindles for $52.11 per day, a saving of 35%.

A contract for a number of new sleeping-cars for the Wagner Company has been let to the Gilbert & Bush Company, on Green Island, Troy, N. Y., for $100,000.

A cheese factory is being erected at Poolville, N. Y., with a capacity for 1,000 cows.

The working force of the locomotive works at Dunkirk has been increased from three to five hundred, in order to fill existing contracts it will be necessary to construct nine engines per month for the ensuing four months.

The Pittsburgh, Pa., Locomotive Works have contracted to build 10 locomotives for the new construction company who are finishing the Texas Pacific R. The locomotives are to be completed in three months. The same works are also making two for the East St. Louis & Carondelet R.

Machinists' and Engineers' Supplies.

New York, Feb. 20, 1880.

The general state of the supply market remains unchanged, and it is thought that prices will not advance any higher at present.

The rumored weakening of the prices on iron pipe is incorrect.

It is rumored that the large auction sale of screws and bolts, which takes place to-day in this city, will have a tendency to lower prices.

G. S. Woolman, 116 Fulton street, N. Y., has taken the agency for Honey's parallel ruler and section liner.

The new rule adopted by the Board of Supervising Inspectors of Steam Vessels requires that all boiler plate for marine purposes, stamped 45,000 lbs. tensile strain, shall show a contraction of fractured area amounting to 15%, with 1% additional reduction of area for every 1,000 lbs. stamped. The effect on trade will be that manufacturers will not stamp over 45,000 lbs; consequently parties building marine boilers in future will have to order heavier plates or higher numbers. Although iron stamped 45,000 lbs. may show much higher tensile strain (some brands running to 60,000 lbs.), yet in view of these requirements makers are not warranted in stamping above 45,000, as tensile strain and reduction of fractured area do not increase equally.

Fisher & Norris, Trenton, N. J., have advanced the price of Trenton Anvils to 10c. per lb. on all anvils of 100 lb. weight, and upward; small anvils are advanced proportionately.

We have received a copy of the new illustrated price-list of James D. Foot, 40 Broadway, New York. He is manufacturers' agent for Wernmann & Kearney's hand-cut files, and Bellamy's special machinists' tools, also dealer in emery wheels, woven linen hose, and pig iron

Iron Review.

New York, Feb. 20, 1880.

The upward tendency is as marked to-day as it has been at any time since the first advance in iron. Good observers say American and British prosperity cannot fail to advance the present rates. If the business "boom" should extend to the continent of Europe prices must push upward to a figure now deemed impossible.

Pierson & Co., 24 Broadway, N. Y., under date of Feb. 20th, 1880, quote prices out of store as follows:

No. 1, X Pig, $42½ per ton; Iron Rails, $68 to $70, according to weight; Old Rails $44 to $45; Fish Plates, 4c. per lb.; Railway Spikes, 4¼c.; Bolts and Nuts, 5½c.; Common Bar Iron, 3 7-10c., basis from store; Refined, 4c., basis; Ulster, 5c., basis; Machinery Steel, 7c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¼c.; Nail Rods, 7c.; Sheet Iron, 5c., basis; Angle Iron, 4 3-10c.; Tee Iron, 4 8-10c; Band Iron, 4 7-10c.; Hoop Iron, 4 8-10c. and up according to size; Horse Shoe Iron, 4 7-10c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets 30% off in papers, 10% off in bulk.

A. B. Warner & Son, 28 & 29 West street, New York quote store prices to-day of boiler-makers supplies: Flange, 6¼c.; C. H. No. 1 Shell, 5¼c., C. No. 1, 4¾c.; Sheets, 4¼c. basis; Boiler Tubes, 5 and 5% discount.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling slip, New York, furnish us the following, under date of Feb. 20, 1880:

During the past week the Metal Market has been without excitement. Pig Tin in London, £96: Singapore, $31. We quote, spot, Banca Tin, 26c.; Straits & Malacca, 23½@23¾c.; Billiton & Australian, 23¼@23½c.; "Lamb & Flag," 23½@23¼c.; Bar Tin, 24¼c.; Pig Lead, dull at 6½c.; Antimony—"Johnson" & "Hallett," 21c.; "Cookson," 24c.; Spelter, steady, 6¾c.; Silesian & Domestic, —; Ingot Copper, 24¼c. @24½c.; Nickel, $1.25; Solder, No. 1, 13c.; "Half & half," 15c.

Situations Wanted—Help Wanted.

We will publish notices suitable for the above headings, applying to any of the machinery trades, and not to exceed four lines each (32 words), at the nominal rate of twenty-five cents for each insertion.

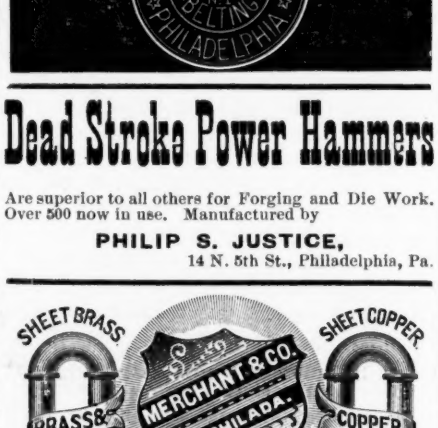
An experienced practical Mechanical Engineer and Draughtsman, competent to design general or special machinery in the best manner, desires an engagement. Address J. J. H., American Machinist office, 96 Fulton street, New York.

Wanted.—50 good machinists and a few boiler makers. Good wages and plenty of work. Address or call at once on W. F. Parish, Supt. Stearns Mfg. Co., Erie, Pa.

Situation wanted by an experienced Practical Draughtsman and Designer on Tools and Special Machinery. Would take charge of an establishment. First-class references. Address B. F. J., care American Machinist, 96 Fulton Street.

TO ENGINE BUILDERS, &c. A strictly first-class man, well up in all modern steam economy, will be open, by the 1st of March, for an engagement, as Superintendent or manager. Middle or Southern states preferred. Address, J. W., care American Machinist, 96 Fulton St., N. Y.

A competent man, who has been machinist, engineer, and master mechanic, wants a position as master mechanic or superintendent of machinery. Best references. Address, A. V., care American Machinist, 96 Fulton St., New York.



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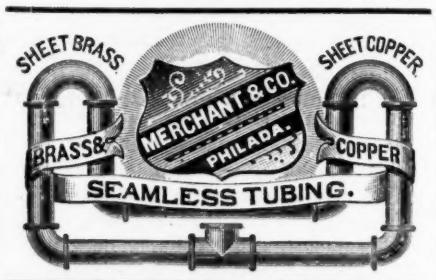

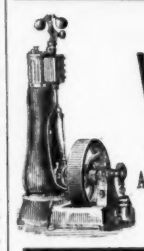
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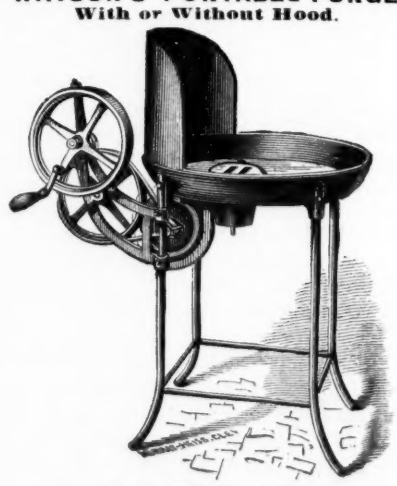

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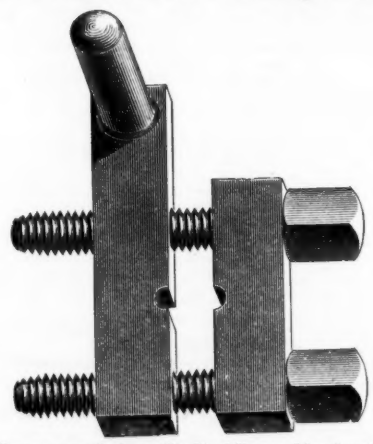

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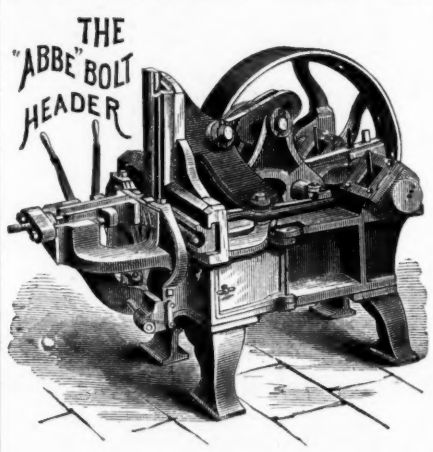

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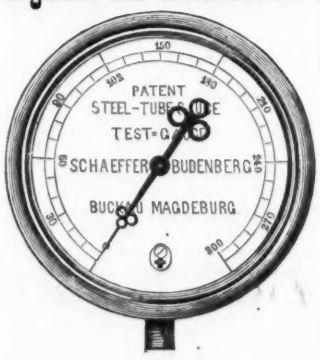

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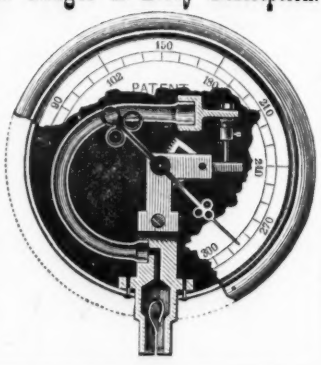

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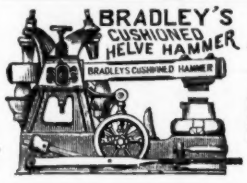

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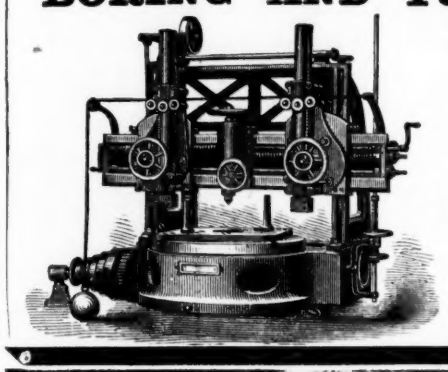

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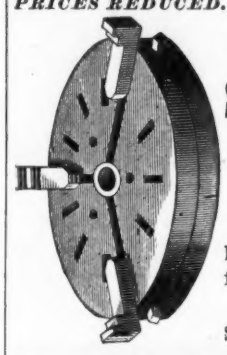

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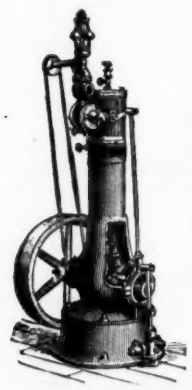

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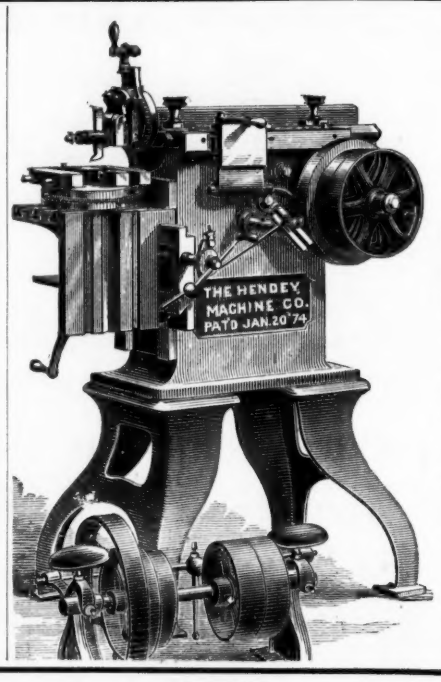

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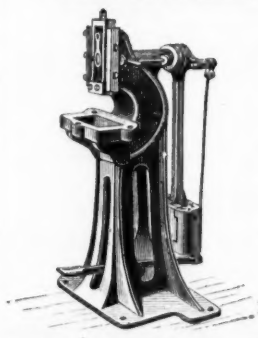

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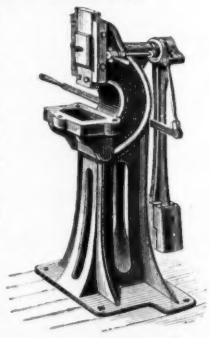

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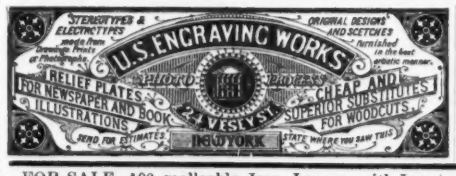
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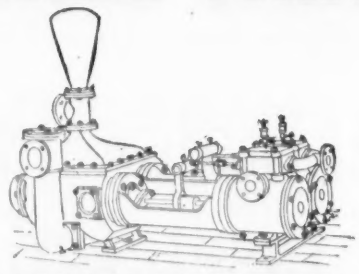

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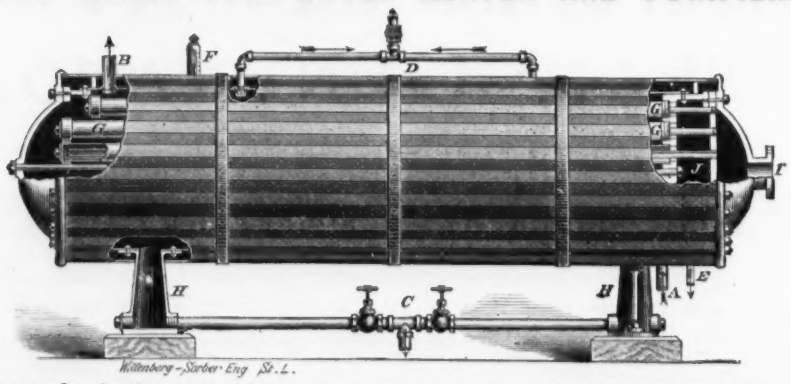

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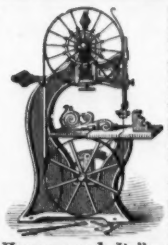

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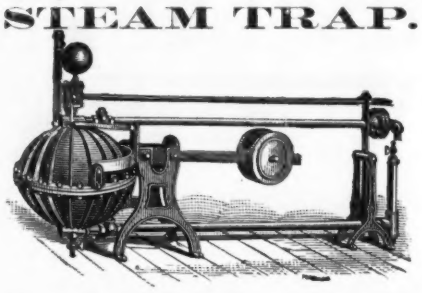

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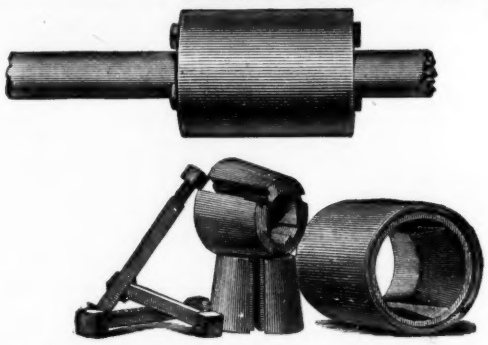

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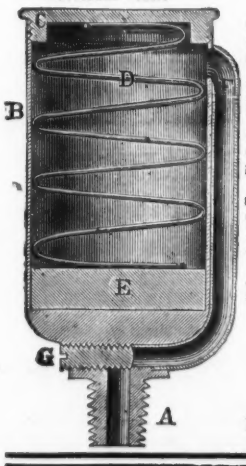

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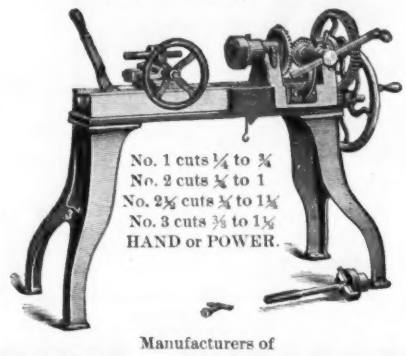

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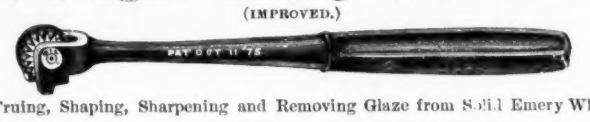

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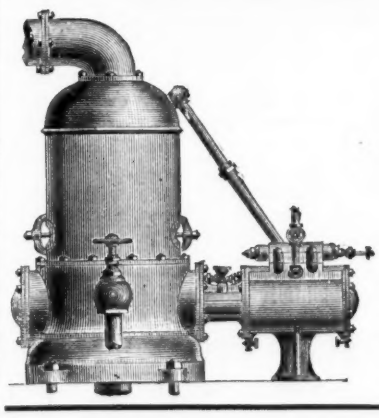

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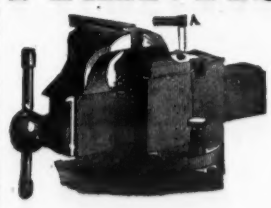

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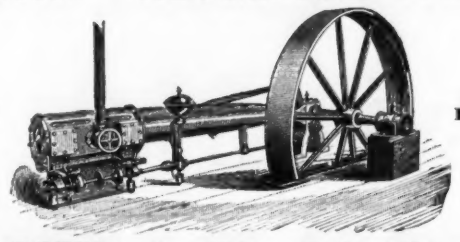

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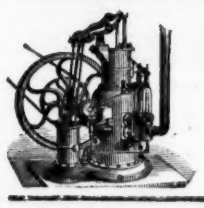

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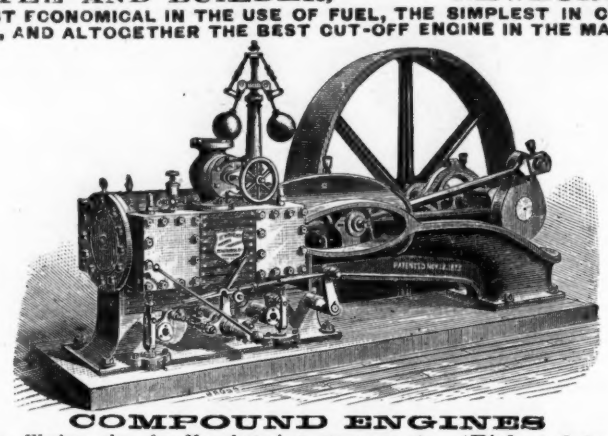

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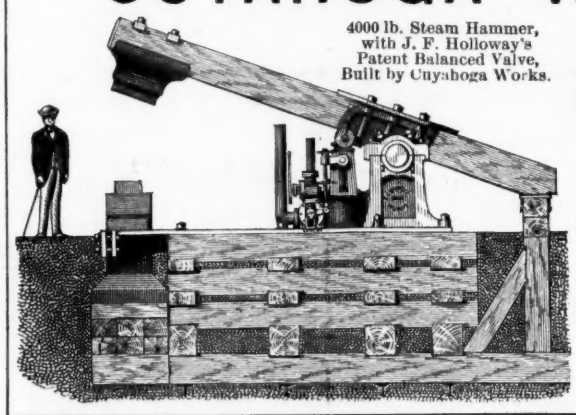

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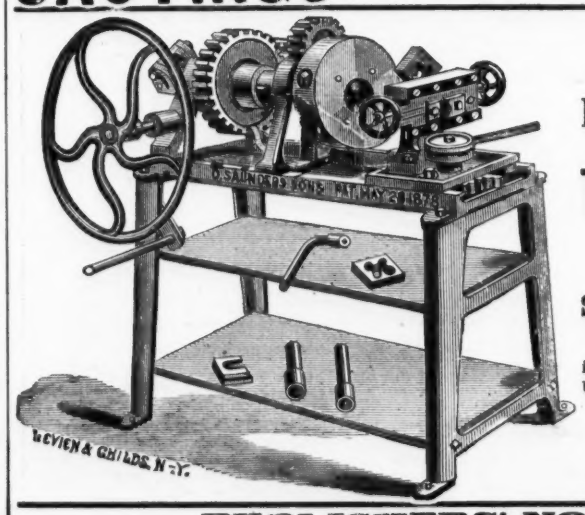

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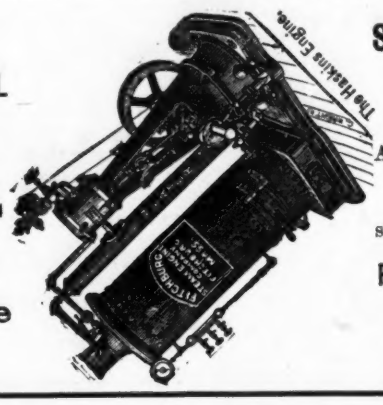

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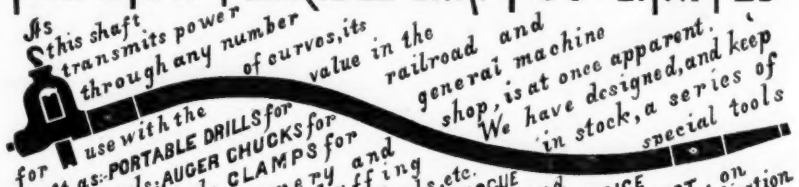
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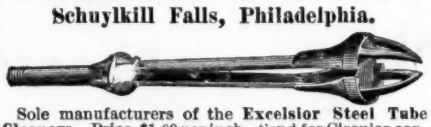

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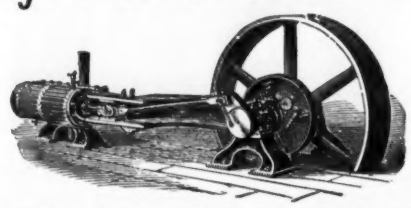

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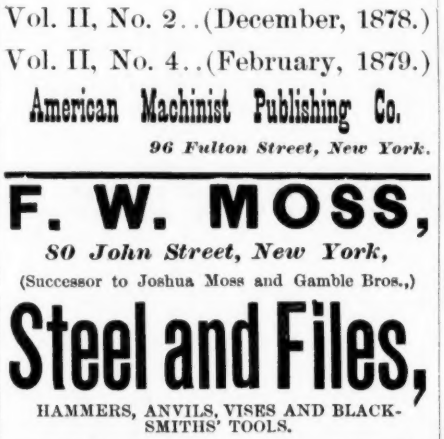

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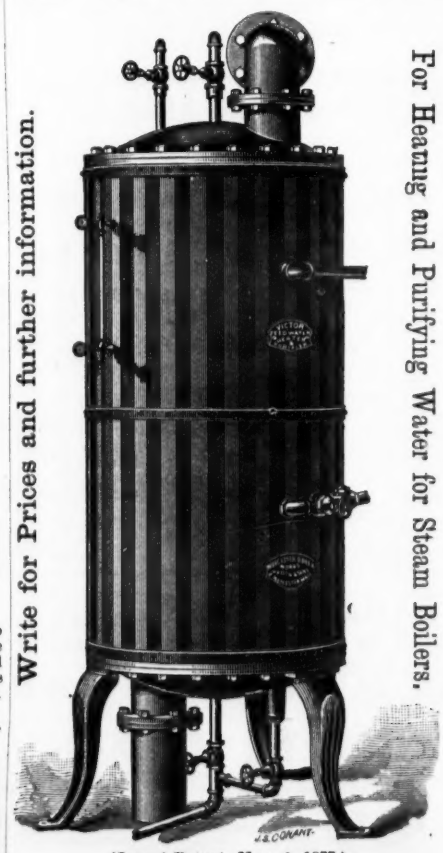

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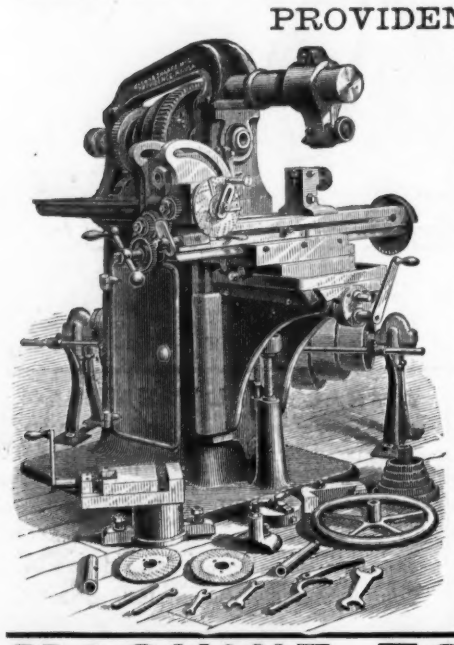

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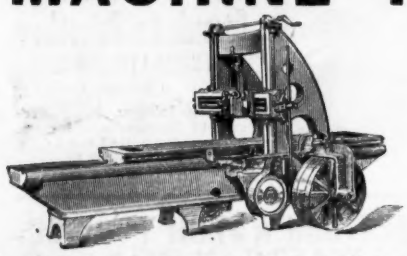

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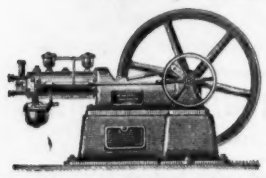

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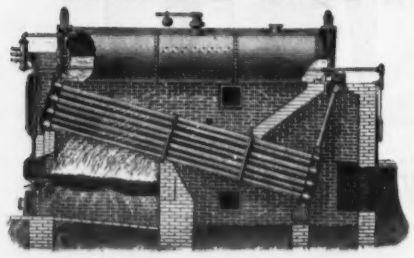

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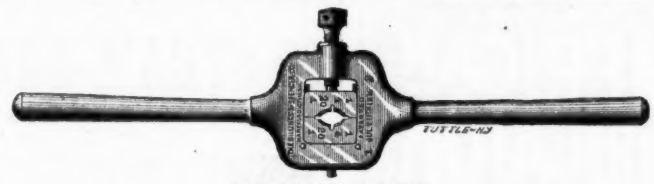

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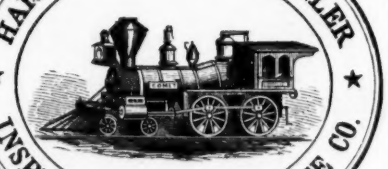

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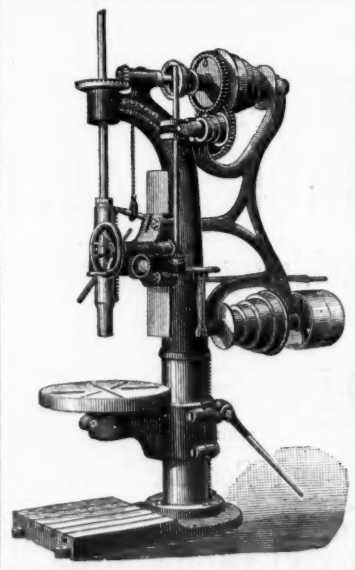

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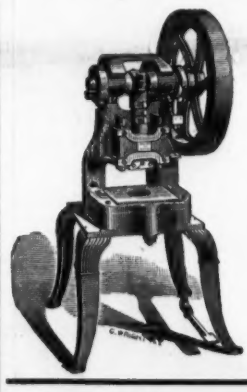

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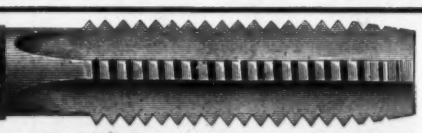

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